

MILESTONE^{T.M.}

A PROJECT MANAGEMENT AND
TIME SCHEDULING PROGRAM

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ORGANIC SOFTWARE

P.O. BOX 2069
Livermore, CA 94550

User's Manual
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NOTICE

Camera ready copy for this manual was prepared using TEXTWRITER by Organic Software, a word processing program for 8080 and Z80 based computer systems. TEXTWRITER is ideal for long documents such as this manual because it automatically generates a Table of Contents and alphabetized index. It also controls micro-spaced letter-quality printers such as Diablo, NEC, and Qume.

PREFACE

At this writing MILESTONE has been in distribution for five months and we at Organic Software are very happy with the response it has received.

We are very grateful to those users who have given us suggestions on improvements to make an excellent program even better. Most of the feedback we have received has been implemented in the latest release, Revision 1.08. We encourage users of this new version to mail us a list of other features they can use, so that we can continue to improve the product.

MILESTONE is succeeding in its goal to provide the essentials of traditional PERT/CPM analysis for a wider range of people. Just as word processors have not replaced photo-typesetting machines, MILESTONE is not intended to replace minicomputer and mainframe PERT/CPM packages. Instead, it is designed to provide the fundamentals of project management in an easy to use package at minimum cost for use on inexpensive microcomputers.

Dr. Michael R. Posehn
President
Organic Software, Inc.
June 1981

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OVERVIEW

You may remember the terms "critical path" and "PERT/CPM" from your days as a student. Well, those terms are no longer restricted to the realm of the space program and large defense projects. Now you can use "critical path network analysis" on your projects. All you need is a desktop microcomputer and MILESTONE.

With today's concerns about increasing costs and declining productivity it is true more than ever that any project worth doing deserves careful planning. Whether you're planning a construction project or the opening of a new retail store, you must carefully schedule your manpower, dollars and time in order to maximize productivity.

This is a chance to increase your productivity by using the latest developments in computer technology. Today, most PERT/CPM programs cost thousands of dollars and run only on large expensive computers. Now MILESTONE provides the fundamental features of critical path analysis at a minimum cost and runs on inexpensive microcomputers.

What is a Critical Path?

Critical-path-network-analysis is a technique originally devised in the late '50s to aid in the planning and development of the Polaris missile system. The basic technique is to divide a complex project into a series of shorter independent tasks and then to analyze their timing to see which ones are critical to the overall completion of the project - Critical in the sense that any delay in a job on the critical path results in a delay of the entire project.

There are basically two methods of critical path analysis, PERT and CPM.

The acronym PERT stands for Performance Evaluation and Review Technique. It treats a project as a series of events occurring in a time sequence and is considered to be a good tool for reporting the progress of a large project. PERT was designed for large research and development projects consisting of numerous activities whose completion times are uncertain. It is based upon probabilistic techniques in order to estimate the expected time required to complete an event.

CPM stands for Critical Path Method (not to be confused with the microcomputer operating system known as CP/M for Control Program/Microcomputer). In contrast to PERT, CPM treats a project as a series of activities and is generally considered to be useful for planning a project. CPM was developed for the construction industry where activity durations can be confidently estimated and trade-offs of cost versus completion date are important.

Implementations of PERT and CPM are typically very expensive and difficult to use. They cost from \$9000 to \$20000, require a large mainframe or minicomputer, and operate in a non-interactive batch mode.

OVERVIEW

MILESTONE's Purpose

MILESTONE is designed to expand the application of critical path analysis to areas where, because computers were so expensive, it would never before have been considered. It combines the fundamentals of critical path analysis into a package that is inexpensive, runs on a desktop computer, and is easy to use.

MILESTONE's design is a product of many years of experience in the "real world" of small-project management. In such an environment the primary purpose of planning is to help the project leader clarify the task at hand and to help him communicate his ideas to his subordinates and superiors. For these two reasons the designers of MILESTONE stressed its interactivity and comprehensive reporting.

Instead of replacing PERT/CPM programs, MILESTONE is designed to complement them. It is designed to be used for the planning and tracking of small projects by a person who does not need sophisticated analysis techniques. Two kinds of managers will find it useful: ones who are not currently using planning tools and ones who are disenchanted with their powerful PERT/CPM packages.

Most projects are small and most small-project project managers are not using formal planning tools. They have probably been exposed to the CPM method in school or in a management course, but are not using CPM because they don't have a computer and or they are tired of pencil and paper CPM calculations. These managers need answers to a few fundamental questions:

- When will the project be completed?
- How much will it cost?
- Is the project ahead of, or behind, schedule?
- How does delaying an activity affect project completion?

MILESTONE is designed to provide answers to these questions quickly and easily.

Some users of mainframe PERT/CPM programs convert to MILESTONE because they are spending more effort and money than is justified for a small project. They find that the batch mode routine of running a mainframe program is too cumbersome to be worthwhile for a small project. As one project leader said after preparing a MILESTONE report, "At that point I had six project engineers beating a path to my door. Although our project has a CPM/PERT system available to us on the central time share system, it is much too difficult to add sufficient detail to be useful in real time."

Others managers use MILESTONE in conjunction with PERT/CPM packages. On a large project like the Space Shuttle, with thousands of activity arrows, every activity is a project in its own right and a candidate for MILESTONE.

What's Special About MILESTONE?

It is interactive. MILESTONE's screen interaction is much like Personal Software's VisiCalc in that you view the project through a moveable screen window. Every time you add a new activity or make a change to an existing one, the entire schedule is recomputed and the new critical path is immediately redisplayed, permitting you to ask "what if" questions about the schedule.

Manpower and cost summaries are optionally displayed at the bottom of the screen, so that you are constantly aware of how schedule changes affect your budget and resources. This immediate feedback permits you to do cost-time tradeoffs, interactively.

It is powerful. Internally, MILESTONE treats your project as a series of activities, each with a name, duration, capital cost, mix of manpower, and prerequisite list (finish/start precedence notation). The list of associated activities provides a thread that MILESTONE uses to link all jobs together into an overall project schedule. A project of one hundred or more activities can be entered without having to draw an arrow diagram or create dummy nodes.

It is easy to use. Much of the design effort was put into eliminating unnecessary or redundant operator input and checking all entries for validity. You run MILESTONE by moving through a menu hierarchy selecting options or changing data with single keystrokes.

It is fast. You have to run MILESTONE to appreciate its speed of response. Because interactivity demands speed, all project data is kept in memory to eliminate disk I/O and all computations use fast integer arithmetic. As you might expect, having all data in memory limits the total number of activities that can be handled. Even so, with MILESTONE it is possible to plan a project with nearly two hundred activities on a 64K byte microcomputer.

It runs on a microcomputer. The ubiquitous eight-bit microcomputer has generated a great demand for powerful yet inexpensive software. MILESTONE is an excellent solution to the challenge of providing interactive critical-path fundamentals within the memory and speed limitations of a small computer.

What Can It Do?

MILESTONE can help plan, schedule, and control any small project. Specifically, it can help you:

- o Find out which activities are time critical and can't be delayed
- o Discover which activities have slack time and can be delayed if necessary without delaying the entire project
- o Prepare a detailed cost estimate based upon a summation of each activity's individual equipment and manpower expenses
- o Change an activity and instantly see the impact on the overall project schedule
- o Investigate the tradeoffs between manpower, dollars, and time.
- o Keep track of your project's progress by periodically updating the schedule to reflect changes in the plan and completed activities
- o Communicate your plan to your project team by giving them a clear picture of what is expected of them, and when

OVERVIEW

- o Use MILESTONE's printed reports to help convince management that your plan is sound

MILESTONE Requirements

If you are not sure whether MILESTONE will run on your computer system, then the following information may help you. If your computer is not listed here, please contact your computer dealer or Organic Software.

COMPUTER - A Z80, 8080, or 8085 running Digital Research's CP/M 2.x
An 8086 running Digital Research's CP/M 86
An APPLE II computer with a language card, APPLE PASCAL 1.1, and a 24x80 video board (Smarterm, etc.)
An APPLE II computer with a language card (or RAM card), Z80 soft card, and a 24x80 video board
A TRS-80 Model II running Digital Research's CP/M 2.x
Any computer running UCSD PASCAL 4.0 by SofTech Microsystems

TERMINAL - Any 24 line by 80 column CRT terminal or video display that has a home-and-clear function and absolute-cursor-positioning

MEMORY - 56K or more bytes of RAM

DISK DRIVES - One or more drives

PRINTER - Any 80 column, or wider, printer

MILESTONE Specifications

To save you the trouble of wading through this long manual in search of a few key numbers, the most important ones are listed here.

Speed - Virtually instantaneous - The critical path is recomputed and redisplayed immediately whenever you make a change to the schedule

Capacity - The number of jobs (activities) per project depends upon the amount of RAM memory available to a user program. This number is strongly dependent on the operating system overhead. A few examples are shown below:

Jobs - System
190 - Digital Research 64K CP/M 2.x
169 - CompuPro 64K CP/M 2.2f
128 - Morrow Discus 2D 60K CP/M Cbios 3.0
102 - Microsoft Apple II CP/M 2.0 56K (64K RAM)
100 - Apple Pascal 1.1
83 - Lifeboat North Star 56K CP/M

To compute the capacity for other CP/M systems, substitute the size of the TPA in the following approximate equation:

$$\text{Capacity} = (\text{TPA} - 46380) / 92$$

Skills - Nine manpower categories with different costs per time-unit

Time Units - Can be measured in hours, days, weeks, months, quarters, or federal fiscal quarters. You can define your normal working hours, working days, and holidays

Duration - Up to 9999 time units

Reports - Four reports including a large time schedule chart made by aligning strips from the printer, and a user defined tabular report

Limitations

It is only fair to list a couple of limitations. MILESTONE does not do resource leveling, resource allocation, or probabilistic scheduling. Although these techniques are necessary for the management of large complex projects, we don't believe they are necessary for most small projects.

EXAMPLES

This chapter outlines how a simple plan is developed with MILESTONE. The first time you read the manual you should skim this chapter and later, after you have read the entire manual, come back and go over this example in more detail.

A Construction Project

This example emphasizes how easy it is to use MILESTONE. Its interactive operation is reminiscent of a word processing program. MILESTONE keeps track of the details, you need only concern yourself with the structure of your project.

This simple construction project exhibits most of the characteristics of a project management plan. The project is to install a new water main in a small town.

Assume for a moment that your name is J. K. Henderson and you are the city engineer in charge of the installing a new water main. Before the project can begin you must come up with a plan and a cost estimate - a perfect job for MILESTONE.

Before you run MILESTONE you think about the project and divide it into several steps.

- o Purchase the pipe - Although this doesn't require any manpower, it will take two weeks for the pipe to be delivered and cost \$50,000.
- o Purchase the pipe fittings - It will take three weeks for the pipe to be delivered and cost \$25,000.
- o Dig the trench - Since this will take one operating engineer and three laborers three weeks, the digging should be started immediately. Other costs will be \$5,000.
- o Lay the pipe - As soon as the pipe and fittings are delivered and the trench is dug, pipe laying can begin. Two welders and four laborers will take four weeks to complete this job. Other costs will be \$13,000.
- o Fill the trench - Two operating engineers and two laborers can fill the trench in two weeks. Rental of equipment is expected to be \$10,000.
- o Repave the street - Three operating engineers, \$30,000, and 2 weeks.
- o Repair the sidewalk - This job will be subcontracted for \$5,000 and take one week.

There are two types of costs in this project, direct outlays for material and indirect manpower costs. Manpower is expected to cost \$1000 per man-week for an operating engineer, \$500 per man-week for a laborer, \$750 per man-week for a welder, and \$1500 per man-week for a civil engineer,.

Enter the project description

With this information in mind, the first step is to create a new MILESTONE project and enter the project description. From the MAIN OPTION menu, select the C(reate option).

CREATE A NEW PROJECT

N(ame of project=First Street Water Main
L(eader of project=J. K. Henderson
T(ime scale=Weeks (Hours, Days, Weeks, Months, Quarters, Fiscal)
S(tart date=1/5/81 (Tue Jan 1)
D(irect cost units=K\$ (Either \$, K\$, or M\$)
M(anpower cost units=\$ (Either \$, K\$, or M\$)
F(ind critical path=yes

To change a project description data-field, press its letter
To quit making alterations, press "Q"

Above is how the screen appears after the name, leader, and start date have been entered. The default direct and manpower cost units need not be changed.

EXAMPLES

Setup the skill categories

The next step is to enter the names of each skill and the corresponding costs.

MANPOWER SKILLS & COSTS

	Description	Cost in \$/Man-Week
1(st skill category=	Operating engineer	1000
2(nd skill category=	Laborer	500
3(rd skill category=	Welder	750
4(th skill category=	Civil Engineer	1500
5(th skill category=		
6(th skill category=		
7(th skill category=		
8(th skill category=		
9(th skill category=		

To change a skill description, press its number

To change a skill cost, press its number and then press TAB

To quit editing the skill categories, press "Q"

Developing the time schedule

Now that all of the preliminary data has been entered, it is time to begin entering each job. It is not necessary to draw up a network diagram if you have a good idea of what steps are involved in the project. Instead, you can interactively add and insert jobs as you think of them.

After selecting the Time Schedule option, select the "Other Options" and turn on the effort and cost summaries, then "Add" the first job.

At the bottom of the screen you can see the data fields as entered for "Purchasing the pipe". Since it has no prerequisites, the early start is set to zero, corresponding to January 5th.

PROJECT SCHEDULE												
	Jan				Feb				Mar			
Revision 1, 1/1/81	5	12	19	26	2	9	16	23	2	9	16	
Job (Room for 128 more)	0	1	2	3	4	5	6	7	8	9	10	
Manpower level=0	0	0	0	0	0	0	0	0	0	0	0	
Manpower cost in K\$=0	0	0	0	0	0	0	0	0	0	0	0	
Direct cost in K\$=50	0	0	0	0	0	0	0	0	0	0	0	
N(ame=Dig 1st part of trench					D(uration=2				C(ost=0			
P(rerequisites=0									E(arly start=0			
Skills 1(=1	2(=3	3(=0	4(=0	5(=0	6(=0	7(=0	8(=0	9(=0				
To enter a field, press its key; to use as is, press RETURN												

EXAMPLES

The screen is redisplayed with a arrow showing the first job.

PROJECT SCHEDULE												
	Jan				Feb				Mar			
Revision 1, 1/1/81	5	12	19	26	2	9	16	23	2	9	16	
Job (Room for 127 more)	0	1	2	3	4	5	6	7	8	9	10	
1 Purchase the pipe	O=====X											
Manpower level=0	0	0	0	0	0	0	0	0	0	0	0	
Manpower cost in K\$=0	0	0	0	0	0	0	0	0	0	0	0	
Direct cost in K\$=50	0	0	0	0	0	0	0	0	0	0	0	
A(dd E(rase or I(nsert a job				move U(p D(own L(ef t R(ight or H(ome								
M(odify or C(omplete a job				O(ther options				Q(uit				
To select an option, press its letter; numbers can prefix a move												

Notice that now there is room for only 127 more jobs in memory. As you add more jobs, you will see this number decrease.

The arrow tail "O" shows that purchasing the pipe has no prerequisites, and the "X" shows that it has no successors. The equals signs "====" tell you that the job is on the critical path. Of course it is critical, at this point there are no other jobs in the project.

Then next two jobs, purchasing the fittings and digging the trench, are entered in a similar manner resulting in a new display.

PROJECT SCHEDULE												
	Jan				Feb				Mar			
Revision 1, 1/1/81	5	12	19	26	2	9	16	23	2	9	16	
Job (Room for 125 more)	0	1	2	3	4	5	6	7	8	9	10	
1 Purchase the pipe	O=====X											
2 Purchase the fitting	O=====X											
3 Dig the trench	O=====X											
Manpower level=4	4	4	0	0	0	0	0	0	0	0	0	
Manpower cost in K\$=2	2	2	0	0	0	0	0	0	0	0	0	
Direct cost in K\$=80	0	0	0	0	0	0	0	0	0	0	0	
A(dd E(rase or I(nsert a job move U(p D(own L(eft R(ight or H(ome												
M(odify or C(omplete a job O(ther options Q(uit												
To select an option, press its letter; numbers can prefix a move												

All three jobs are shown as critical because they are in parallel and totally independent. Later, after adding other jobs, the slack times appear.

The manpower level shows that four people are working during the first three weeks. The manpower cost is only approximate because it is rounded down to the next lowest level in K\$. Approximations are used in the cost summary to make the computations fast and to conserve memory. Totals that appear on the printed reports, however, are accurate to four significant digits.

The direct cost total shows that \$80,000 must be committed to the project in the first week.

EXAMPLES

The next screen shows the time schedule after "Laying the pipe" has been added.

PROJECT SCHEDULE											
	Jan				Feb				Mar		
Revision 1, 1/1/81	5	12	19	26	2	9	16	23	2	9	16
Job (Room for 124 more)	0	1	2	3	4	5	6	7	8	9	10
1 Purchase the pipe	O----->....>										
2 Purchase the fitting	O=====>										
3 Dig the trench	O=====>										
4 Lay the pipe	>=====X										
Manpower level=4	4	4	4	4	4	4	4	0	0	0	0
Manpower cost in K\$=2	2	2	2	2	2	2	2	0	0	0	0
Direct cost in K\$=80	0	0	13	0	0	0	0	0	0	0	0
A(dd E(rase or I(nsert a job move U(p D(own L(eft R(ight or H(ome											
M(odify or C(omplete a job O(ther options Q(uit											
To select an option, press its letter; numbers can prefix a move											

The arrow ending with "X" shows that this phase of the project will be completed by February 23. Also note that Job 1, purchasing the pipe, has one week of slack time. This means that a week's delay in pipe delivery will not delay the project.

Jobs 2 and 3 are both critical. Although they are in parallel, the fact that their durations are equal makes them both critical.

The next screen shows the time schedule after all eight jobs have been added.

PROJECT SCHEDULE												
	Jan				Feb				Mar			
Revision 1, 1/1/81	5	12	19	26	2	9	16	23	2	9	16	
Job (Room for 120 more)	0	1	2	3	4	5	6	7	8	9	10	
1 Purchase the pipe	O----->....>											
2 Dig trench	O=====>											
3 Purchase fittings	O=====>											
4 Lay pipe	>=====>											
5 Fill trench	>=====>											
6 Repave street	>=====											
7 Repair sidewalk	>----->..											
8 Project completed												
Manpower level=4	4	4	6	6	6	6	4	4	3	3		
Manpower cost in K\$=2	2	2	3	3	3	3	3	3	3	3		
Direct cost in K\$=80	0	0	13	0	0	0	10	0	35	0		
A(dd E(rase or I(nsert a job move U(p D(own L(eft R(ight or H(ome												
M(odify or C(omplete a job O(ther options Q(uit												
To select an option, press its letter; numbers can prefix a move												

Completion of the project is off the screen to the right. To see the end of the project, the user can type "4L" and move the display four time units to the left.

At this point the project leader can refine the schedule by splitting jobs into parts or by adding other jobs as necessary.

EXAMPLES

This last screen shows the time schedule after the user has modified the job sequence in an attempt to complete the project in a shorter time.

PROJECT SCHEDULE												
	Jan				Feb				Mar			
Revision 1, 1/1/81	5	12	19	26	2	9	16	23	2	9	16	
Job (Room for 117 more)	0	1	2	3	4	5	6	7	8	9	10	
1 Purchase the pipe	O	----->....>										
2 Dig 1st part of trench	O	----->....>										
3 Purchase fittings	O	=====>										
4 Lay 1st part of pipe					=====>							
5 Dig 2nd part of trench					>----->.....>							
6 Fill 1st part of trench								>----->....>				
7 Lay 2nd part of pipe							=====>					
8 Fill 2nd part of trench								>=====>				
9 Repair sidewalk									>----->....>			
10 Repave street									=====>			
11 Project completed											X	
Manpower level=4	4	4	6	6	6	6	4	4	3	3		
Manpower cost in K\$=2	2	2	3	3	3	3	3	3	3	3		
Direct cost in K\$=80	0	0	13	0	0	0	10	0	35	0		
A(dd E(rase or I(nsert a job move U(p D(own L(ef t R(ight or H(ome												
M(odify or C(omplete a job O(ther options Q(uit												
To select an option, press its letter; numbers can prefix a move												

The original steps of digging the trench, laying the pipe, and filling the trench were each broken down into two parts so that some of the work could be overlapped. For example, you can lay the first part of the pipe after the first part of the trench is dug but before the second part has been dug.

The steps were broken into parts by using the modify and insert options. First, the existing job was modified to have a new name and a shorter duration. Then, a new job was inserted into the schedule after the original one. This new job was the second half of the original step.

It is this type of user interaction that makes MILESTONE unique among project planning programs. The user can ask "What If?" questions and immediately see the impact on his project.

GETTING STARTED

On a CP/M System

STEP 1 - First, make a copy of the MILESTONE diskette and put the original in a safe place. **NEVER USE THE ORIGINAL DISKETTE!** Then load the copy into your second disk drive, log-onto drive B, and list the directory.

```
A>b:
B>dir
B:PRUN      COM : PASLIB   PCO : CONFIG   PCO : ORGANIC  DAT
B:LEARNHOW  PCO : MILESTON PCO : EXAMPLE1 DES : EXAMPLE1 JOB
B:EXAMPLE2  DES : EXAMPLE2 JOB : EXAMPLE3 DES : EXAMPLE3 JOB
```

The file named 'prun.com' is the PASCAL/M interpreter by SORCIM corporation. Your copy of 'prun' will be either for CP/M 2.x or for CP/M-86, depending on the type of computer system you specified on your order. The file named 'paslib.pco' is the run-time library. Together these files comprise the PASCAL/M 'run-time package'. Although MILESTONE was written in PASCAL and compiled with PASCAL/M, you still need the run-time package.

Organic Software has entered into an agreement with SORCIM to allow the distribution of the PASCAL/M interpreter and run-time library along with each copy of MILESTONE. If you like MILESTONE and would like to write similar programs of your own, we suggest that you purchase a complete SORCIM PASCAL/M package that includes the PASCAL compiler.

STEP 2 - Configure the terminal, printer, and data disk by running the program named "CONFIG" (See the chapter titled "Configuring Your Terminal and Printer").

```
B>prun config
```

STEP 3 - While running "CONFIG" you will see three different screens and menus. Pick the proper terminal, set your printer width in columns, and make sure the data drive is set to "B".

STEP 4 - Run LEARNHOW and practice entering different types of data.

```
B>prun learnhow
```

STEP 5 - Run MILESTONE.

```
B>prun milestone
```

STEP 6 - When you see the STARTUP menu, make the following entries,

```
press T, enter the date, and press TAB
enter your name and press RETURN
press C to continue
```

STEP 7 - Now the MAIN OPTIONS should be displayed on the screen. To begin the demo, press L to load a project into memory.

STEP 8 - To load the first example into memory, press F to select the file name

GETTING STARTED

and then enter "example1" and press RETURN. Then load the project into memory by pressing L.

STEP 9 - When the file is found, type Y to verify your choice and then you're off and running.

On a UCSD or APPLE PASCAL System

STEP 1 - First, make a copy of the MILESTONE diskette and put the original in a safe place. **NEVER USE THE ORIGINAL DISKETTE!** Then load the copy into your second disk drive.

STEP 2 - Load a system disk in the first drive and boot your system (**NOTE: The system disk must contain the file named "SYSTEM.LIBRARY"**). Execute the FILER, set the prefix to the second drive, and list the directory.

```
Command: E(dit, R(un, F(ile, C(omp, L(ink, X(ecute, A(sssem, D(ebug? F
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate, Q(uit? P
Prefix titles by what vol? #5
Prefix is MSTONE:
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate, Q(uit? L
Dir listing of what vol? :
CONFIG.CODE      43    27-DEC-80
ORGANIC.DAT      13    27-DEC-80
MILESTONE.CODE   106   27-DEC-80
EXAMPLE1.DES     1     27-DEC-80
EXAMPLE1.JOB     2     27-DEC-80
EXAMPLE2.DES     1     27-DEC-80
EXAMPLE2.JOB     3     27-DEC-80
EXAMPLE3.DES     1     27-DEC-80
EXAMPLE3.JOB     5     27-DEC-80
EXAMPLE4.DES     1     27-DEC-80
EXAMPLE4.JOB     3     27-DEC-80
EXAMPLE5.DES     1     27-DEC-80
EXAMPLE5.JOB     3     27-DEC-80
EXAMPLE6.DES     1     27-DEC-80
EXAMPLE6.JOB     2     27-DEC-80
```

STEP 3 - Quit the FILER and then configure the terminal, printer, and data disk by running the program named "CONFIG" (See the chapter titled "Configuring Your Terminal and Printer").

```
Filer: G(et, S(ave, W(hat, N(ew, L(dir, R(em, C(hng, T(rans, D(ate, Q(uit? Q
Command: E(dit, R(un, F(ile, C(omp, L(ink, X(ecute, A(sssem, D(ebug? X
Execute what file? config
```

STEP 4 - While running "CONFIG" you will see three different screens and menus. Pick the proper terminal, set your printer width in columns, and make sure the data drive is set to "#5".

STEP 5 - Run LEARNHOW and experiment with entering data.

CONFIGURING YOUR TERMINAL & PRINTER

Before you run any Organic Software program, you must first run the program named CONFIG. It creates a special data file named "terminal.dat" that contains all information needed to control your particular terminal and printer.

If, at a later date, you have changed your terminal or printer, you can then rerun CONFIG to change the data file.

Whenever you run an Organic Software program, you must be sure that the file named "terminal.dat" is present on the currently logged disk drive.

Terminal Selection

After running CONFIG, the first screen you see is the terminal selection menu.

```
CONFIGURE, Revision 1.03
Copyright (c) 1980, 1981 by Organic Software, Inc.

This program is now configured for a

It can be changed to one of the following terminals,

A( ANSI Standard terminal  M( Heath H19 & H89          Y( Tektronix 4025
B( ADDS Regent 20 & 25     N( HP 2641A & 2645A       Z( Televideo 912 & 920
C( ADDS Regent 40 & 60     O( HP 2621                0( TI 911 VDT
D( Apple II M&R Superterm  P( Intertec Superbrain    1( TRS-80 MOD II FMG
E( Apple II Smarterm       Q( Lear Seigler ADM 3A      2( TRS-80 MOD II LBA
F( Apple II Videx Video    R( Lear Seigler ADM 42      3( TRS-80 MOD II P&T
G( Beehive Micro B 2       S( MicroTerm ACT IV & V    4( Vector MZ Video
H( Data Media Elite 1520   T( Perkin Elmer 550         5( VIO-C Video Driver
I( DEC VT-52              U( Perkin Elmer 1100        6( Zenith WH19
J( DEC VT-100 ANSI Mode   V( Perkin Elmer 1200        7( Zentec Zephyr
K( Hazeltine 1410         W( Soroc IQ 120 & 140       8(
L( Hazeltine 1500 & 1510  X( SSM VB3 ICRT Driver     9( Terminal Not Shown

To change the terminal, press the corresponding letter
To quit, press ESC; to leave as shown, press RETURN
```

The screen lists some of the most popular terminals used with small computers. If yours is listed, then press its letter. If it is not listed, the press "9" and follow the instructions in Appendix B.

GETTING STARTED

Command: E(dit, R(un, F(ile, C(omp, L(ink, X(ecute, A(ssem, D(ebug? X
Execute what file? **learnhow**

STEP 6 - Run MILESTONE.

Command: E(dit, R(un, F(ile, C(omp, L(ink, X(ecute, A(ssem, D(ebug? X
Execute what file? **milestone**

STEP 7 - When you see the STARTUP menu, make the following entries,

press **T**, enter the date, and press **TAB**
enter your name and press **RETURN**
press **C** to continue

STEP 8 - Now the MAIN OPTIONS should be displayed on the screen. To begin the demo, press **L** to load a project into memory.

STEP 9 - To load the first example into memory, press **F** to select the file name and then enter "**example1**" and press **RETURN**. Then press **L** to load it in.

STEP 10 - When the file is found, type **Y** to verify your choice and then you're off and running.

CONFIGURING YOUR TERMINAL & PRINTER

Printer Selection

The printout options govern how output reports are to be printed. Some of them depend upon the physical characteristics of your printer, others depend upon how you want reports to be formatted.

PRINTOUT OPTIONS

D(evice name=printer:
W(idth in columns=80
H(eight in lines=66
T(op margin=3
B(ottom margin=3
L(eft margin=1
R(ight margin=80
U(se form-feeds=Yes
P(ause at page end=No

To change a variable, press its letter, "D" "W" "H" etc.
To quit with no changes, press ESC
To leave as shown, press RETURN

D(evice name

Normally you will direct the printout to your printer (it's called "printer:", not "lst:" on CP/M systems), however, by changing the device name you can redirect the output to a disk file or any other device. Although legal device names on CP/M systems are limited to "printer:", "punch:" and "null:", you can could direct the output to a different device by using the STAT command.

If the output is to a disk file, then you can insert it directly into a report using a text formatting program such as **TEXTWRITER** by Organic Software.

W(idth in columns

You can use a printer of any width. Most printers print a ten characters per inch on paper either eighty or one hundred thirty-two columns wide. Others can print at twelve or sixteen and a half characters per inch. Although most reports use only eighty columns, some can use up to 255 (For example, the MILESTONE time schedule report.

After running MILESTONE for a while, you may wish to rerun this program and

change the printer width. For example, some printers automatically to a linefeed whenever an 80 column line is printed, causing the output to be double spaced. If this is true for you, then change the printer width to 75 columns.

H(eight in lines

The most common page height is sixty-six lines, corresponding to six lines per inch and a paper length of eleven inches. However, some printers can print at eight or more lines per inch producing eighty-eight or more lines per page.

You must specify the page height so that the program can keep track of where it is on the page. If you are using fan-fold paper and a printer that responds to form-feeds, then this number may be less than the actual number of lines per page. If your printer does not do form-feeds, then this number must be exactly equal to the actual number of lines per page.

T(op margin

Any number of lines may be skipped at the top of each page. Normally this should be set at three to leave one-half inch at the top of the page, however, you may make it any value you wish.

B(ottom margin

Any number of lines may also be skipped at the bottom of each page. Normally this should be set at three to leave one-half inch at the bottom of the page, however, you may make it any value you wish.

L(ef and R(ight margin

You can also specify the position of the left margin and right margins for some reports and printouts. The margin value along with the three previous values mentioned above gives you complete control over the position of the printing on your printer paper. (NOTE: These two parameters are intended for word processing applications and are not used by MILESTONE.)

U(ser form-feeds

Set this value to "YES" if your printer is capable of responding to an ASCII form-feed character. It causes the paper to be advanced as fast as possible to the beginning of the next sheet. (NOTE: It will have an effect only if the bottom margin is non zero.)

P(ause at page end

If you intend to use single sheets of paper in your printer, then you must have this option set to "YES", so that the program will stop at the end of each page ready for you to insert another single sheet.

There are two ways to load single sheets into your printer: so that the print element is ready to print on the very first line of the sheet, or rolled up one inch (and held against the platen by the pressure bail) so that the element is ready to print on the seventh line of the sheet. If you intend to roll the paper up one inch, then you must change the top margin to 0 and the paper length

CONFIGURING YOUR TERMINAL & PRINTER

to 60 lines.

Disk Drive Selection

DISK DRIVE OPTIONS

D(ata drive name=A

To change a variable or select an option, press its letter
To quit with no changes, press ESC
To leave as shown, press RETURN

D(ata drive name

This is the name of the disk drive normally holding data files. It is used as a default only and can be overridden at any time. If you have a dual disk system, you should probably keep programs on the first drive and data on the second.

LEARNING HOW TO ENTER DATA

To help you learn how to run programs provided by Organic Software, we have created a special program called "LEARNHOW". It may be a little different from what you have learned running other computer programs, but we think you will find it to be much better.

To get started, first run CONFIG, then run LEARNHOW.

```
LEARNHOW, Revision 1.03
Copyright (c) 1981 by Organic Software, Inc.
Learn how to enter data and to select options
```

DATA FIELDS:

```
I(nteger variable=101
S(tring variable=Hello
  C(lock time=12:00
D(ay of the year=1/1/80
```

OPTIONS:

```
A(dd one day to the date shown above
Q(uit this program
```

To change a variable or select an option, press it letter

All programs created by Organic Software use screen displays in the same general format. At the top left-hand corner is the title of the display. (Display titles are always listed in the manual index for quick reference.)

Next is a list of data fields. You can tell they are data fields because they are denoted by a noun-phrase followed by an equals-sign and a value. (The value is highlighted, if possible on your terminal.) To change a data-field, press the corresponding letter (It's capitalized and followed by a left parenthesis).

After the data fields is a list of options usually denoted by verb phrases. In the example above, "A(dd one day" means to increment the date shown in the data field. Whenever you press an option letter, the option is performed immediately - you need not press RETURN.

At the very bottom of the screen, you will usually find a prompt message. It is typically a series of sentences listing likely actions you will want to make followed by a reminder on how to proceed. Sometimes when you change a data

LEARNING HOW TO ENTER DATA

field, this prompt message will change and give you specific instructions about the data-field you selected.

When the program you are running displays a special screen of data, then the data-fields and options are packed into a few lines at the bottom of the screen, to save space. You still should be able to recognize your choices by looking for capital letters followed by left parenthesis.

Special Keys

Although the American National Standards Institute (ANSI) has published a standard for computer terminals, very few manufacturers follow it. As a result, most computer keyboards are slightly different.

Below are listed several actions you will wish to perform along with the keys you will need to press. Each action has several possible keys; use the one that you can find on your keyboard.

To backup the cursor one position,

BACKSPACE, DELETE, DEL, RUBOUT, RUB, or CTRL-H (ASCII BS or DEL)
Don't try to use the back-arrow key, unless you are sure that it generates an ASCII BS.

To quit entering data and ignore changes that have been made,

ESCAPE or ESC (ASCII ESC)

To quit entering data and leave all values as shown on the screen,

RETURN or ENTER (ASCII CR)

To skip forward to the next data field,

TAB or CTRL-I (ASCII HT)

To skip backward to the previous data field,

BACKSPACE, DELETE, DEL, RUBOUT, RUB, or CTRL-H (ASCII BS or DEL)
Skip back only works from the first position in a data field.

General Rules

RULE #1 - Always read the prompt message at the bottom of the screen for special instructions.

RULE #2 - You don't need to press RETURN (or ENTER on some computers) when selecting a data field or option, because the key is accepted as soon as you press it.

RULE #3 - To quit and return to the previous menu, or end the program, press "Q".

RULE #4 - Once you have selected a data field, you may press ESC if you have changed your mind. Regardless of what data you may have entered, it will be ignored and the data-field will be restored to its previous value.

RULE #5 - After you have entered a new data field, you may press:

RETURN if the data is correct and you want to stop entering data.

TAB (or CTRL-I on some keyboards) to skip to the next data field (The order is from left to right across the screen and then top to bottom).

BACKSPACE to backup one character position. If the cursor is at the very beginning of a data field, it will skip to the beginning of the previous data field. If your terminal does not have a BACKSPACE key, then try RUBOUT, DELETE, or CTRL-H (i.e. hold down the key labeled CTRL and simultaneously press H). One of these combinations will backup the cursor.

ESC to erase the data you have entered and quit data entry.

RULE #6 - If you type an illegal character, it will be ignored and you will hear a bell ring. You may also see an error message displayed at the bottom of the screen.

RULE #7 - To terminate data entry, you must press RETURN, TAB, or ESC; otherwise, a bell will ring.

Entering Integers

Integers are the easiest data values to enter because it is virtually impossible to make a mistake. Only legal digits are accepted; all other key presses are ignored.

To change the integer variable to a value of 99, for example, press the letter "I". The cursor will jump up to the first position of the integer variable.

```
I(integer variable=101
```

Next, press the "9" on your keyboard.

```
I(integer variable=9...
```

The number 9 is then displayed followed by three dots indicating that at most three more digits can be entered. The number of allowable digits is controlled by the program depending upon the range of integers that are allowed for the particular variable. This is a form of error checking that prevents you from

LEARNING HOW TO ENTER DATA

entering a number that is too big for the program to handle.

Since you want the new value to be 99, you should press "9" again.

```
I(nteger variable=99_.
```

Now that the integer appears that way you want it, you can press RETURN.

Try entering some other integers. If you get confused, then read the general rules listed earlier in this chapter.

Entering Strings of Characters

Names or other words are usually input as strings of characters.

To change a string variable, press the first letter of its name and the cursor will jump up to the first character position.

```
S(tring variable=H_ello
```

For example, lets change "Hello" to "Hi". First press the letter "H".

```
S(tring variable=H_.....
```

The first letter is immediately displayed followed by a series of dots indicating the maximum allowable length of the string. When you have finished entering the string, press TAB or RETURN depending on the message displayed at the bottom of the screen.

Here is an example of how you would change the name John Smith to Jane Doe.

```
S(tring variable=John Smith      (the data field showing the initial name)
S(tring variable=J.....        (after you have pressed "J")
S(tring variable=Jane Doe.....  (after you have completed the name)
S(tring variable=Jane Doe        (after you have pressed RETURN)
```

If you make a mistake, you can backup as describe in RULE #5 above.

Entering Dates

Dates are always entered in the format "mm/dd/yy" where "mm" stands for the month number, "dd" stands for the day number, and "yy" stands for the year.

When you are asked to enter a date, it is shown with some default value. You press a series of keys to change the date to the one you want. Once it is displayed the way you want it, you press either TAB or RETURN depending on the instruction at the bottom of the screen.

If the cursor is positioned at the month field and the month already has the value you want, then press "/" to skip over to the day field. Likewise, pressing "/" again will skip to the year field.

Each key you press is checked for validity and ignored if it would produce an impossible date. For example, trying to enter the 29th of February in a non-leapyear causes the bell to ring. In a very rare circumstance it may be necessary to first change the year and then backup to the date.

To illustrate date entry, assume that the date were initially set to the first of June 1980. The following key sequences could change it to other dates.

New date	Key sequence
May 15, 1981	"5/15/81"
July 1, 1980	"7/1/80" or just "7"
June 2, 1980	"/2"
July 4, 1980	"7/4"
June 1, 1981	"//81"

Table 1: Key sequence require to change "D(ate=6/1/80" to a new date.

There is also a quick way to compute a new date. Say for example, you want to change the date shown to a new date forty-five days later - just type in "+45d" and the new date is computed and displayed. Here's what you would see,

```
D(ay of the year=1/1/80
D(ay of the year=+45d
D(ay of the year=2/15/80
```

You can go forward or back in time by entering either "+" or "-", followed by up to three digits, and then "d" for days, "w" for weeks, "m" for months, and "y"

LEARNING HOW TO ENTER DATA

for years.

For example,

+60d	adds sixty days
-180d	subtracts one hundred eighty days
+3w	adds three weeks
-2w	subtracts two weeks
+6m	adds six months
-1y	subtracts one year

Entering Times

Times are always entered in the format "hh:mm" where "hh" stands for the hour and "mm" stands for the minutes. As with entering dates you need only press the keys required to change the displayed time to the time that you want.

For example, if a time were initially set to noon, the following key sequences could change it to other times.

New time	Key sequence
3:45	"3:45"
1:00	"1"
0:30	":30" or ":3"
12:30	"12:3"

Table 2: Key sequence require to change "T(ime=12:00" to a new time.

OPERATION

Running MILESTONE on CP/M

To run MILESTONE on a CP/M system, first boot CP/M, log-on to the disk drive with the files PRUN.COM, PASLIB.PCO, MILESTONE.PCO, and TERMINAL.DAT, Then type the following line, followed by RETURN.

```
A>prun milestone
```

You don't need to type the "e" at the end of the word "milestone" because the CP/M system only uses eight character file names anyway.

Running MILESTONE on UCSD or APPLE PASCAL

Boot your system, run the FILER to set the prefix to the drive containing MILESTONE.CODE and TERMINAL.DAT, and then press "X" for X(ecute).

```
Execute what file?milestone
```

MENUS AND DISPLAYS

This chapter describes each screen display and option menu in detail. The information in each display is from the first example project discussed in the Overview chapter.

Startup Menu

When MILESTONE is started, the terminal screen is cleared and the startup menu is displayed. It gives you the chance to enter new values for two data fields, the date and your name.

At the top of the Startup Display is the title of the program, the revision number, a copyright notice, and a serial number. To receive verbal or written help from your software distributor or from Organic Software, you must always state your serial number and revision level so that we can check it against our file of signed Registration Cards.

As clearly stated in the Purchaser-Licensee Agreement in the beginning of this manual, use of this program is restricted to one computer system. To guard against copyright infringement each copy of the program is serialized and registered to the purchaser. If the copyright notice and serial number are altered in any way, the program will cease to function.

```
MILESTONE, Revision 1.08, Room for 128 jobs in memory
Copyright (c) 1981 by Organic Software, Serial Number 000001
```

STARTUP DATA:

```
T(oday's date=1/1/80
Y(our name=
```

STARTUP OPTIONS:

```
C(ontinue MILESTONE
Q(uit MILESTONE
```

```
To change "T(oday's date", press "T"
To change "Y(our name" press "Y"
To quit MILESTONE, press "Q"; to continue, press "C"
```

MILESTONE keeps a small work file (named MILESTON.WRK) on disk. This file

contains some information about your last MILESTONE session to make it easy to pick up where you left off. In the file it keeps the date, your name, and the name and disk drive of the last project you worked on.

If the date and name are correct as shown, then press "C" and MILESTONE will continue. If you have changed your mind and want to quit, press "Q". But, if you want to change either of the two data fields, follow the instructions below.

T(oday's date

When MILESTONE is first started, it reads the file named "mileston.wrk" to find the date when the it was last run. If the date is no longer correct, press the letter "T" and enter a new date (rules for entering dates are listed the chapter titled "Learning How To Enter Data").

Y(our name

The second item of startup data is your name. Eventhough you are preparing this project plan, you may not be the project leader. If this is true, you should enter your name here so that it will appear on all printed reports, giving you proper credit for your work.

MENUS AND DISPLAYS

Main Option Menu After Startup

After the startup data has been entered, the MAIN OPTIONS are displayed. They are called the "Main Options" because they are the first options displayed and because all other options return to them upon completion.

MILESTONE MAIN OPTIONS

There is no project in memory at this time

C(reate a new project

L(oad a different project into memory

Q(uit MILESTONE and return to the operating system

To begin work, press "C" or "L" to create or load a project

To end MILESTONE, press "Q"

Look on the third line of the display and you can see a message indicating that there is no project in memory. Before you can do anything else, you must first either create a new project or load one in from disk.

C(reate a new project

Select this option if you want to start from scratch and completely describe a new project. All of the project data is initialized to a standard set of default values, and then the project description is displayed, ready for changes.

L(oad a different project into memory

As mentioned earlier, all project data is stored in two associated disk files. The "L(oad" option reads these disk files into memory so that you can display your project on the screen, make changes to it, or print one or more reports on the printer.

Main Option Menu After Loading

After a project has been loaded into memory, the MAIN OPTIONS look different. First, you will notice that the name of the project is listed on the third line of the display. You will also notice that there are three other options available.

MILESTONE MAIN OPTIONS

The current project in memory is "First Street Water Main"

C(reate a new project
L(oad a different project into memory

M(odify or display the current project

P(rint one of the project summary reports

S(ave the current project on disk
Q(uit MILESTONE and return to the operating system

To select a different project, press either "C" or "L"
To modify the current project, press "M"
To print a project summary report, press "P"
To end MILESTONE, first save your work with "S" and then press "Q"

C(reate new project

Select this option if you are finished working on the project in memory and wish to start from scratch with another. After first checking to make sure you have saved your work, all of the project data in memory is erased and re-initialized to a standard set of default values. Then the project description is displayed, ready for changes.

Don't worry. If a project has been loaded and changed, you will be warned before the data is erased.

L(oad a different project into memory

First a reminder about disk files. As mentioned earlier, all project data is stored in two associated disk files. The "L(oad" option reads these two files into memory so that you can work with them.

By providing the load option and the save option, you are given explicit control over your project files. However, along with this control comes the

MENUS AND DISPLAYS

responsibility to manage the files intelligently. Although MILESTONE always gives you fair warning before erasing any information, it is up to you to save your own work and to periodically make backup copies of your important project files.

M(odify the current project

This is the most frequently selected option because you must use it to change any of the data that make up a project. When it is selected, it causes the Modify Options to appear on the screen. You may then modify any of the four data groups that define a project.

P(rint summary reports

Choose this option whenever you want to make a printout of the project schedule or any other project report on your printer. The printout is a permanent record of your work that you can hang on your office wall, show to others, or include in your project documentation.

See a complete discussion of the "P(rintout reports" later in this manual.

S(ave the project on disk

As mentioned above, all project data is stored in two associated disk files. The "S(ave" option writes from memory into the disk file so that you can save your work.

Be careful! The old project files are destroyed in the process of saving the new ones.

Q(uit MILESTONE

To end a MILESTONE session, press the letter "Q". If you have not saved your work, you will be warned.

Create a New Project

The project description is made up of six data fields, normally the first data that you enter when creating a new project. The most important one is the "Time scale" and you should consider it carefully.

CREATE A NEW PROJECT

N(ame of project=
L(eader of project=
 T(ime scale=Weeks (Hours, Days, Weeks, Months, Quarters, Fiscal)
 S(tart date=1/1/80 (Tue Jan 1)
D(irect cost units=K\$ (Either \$, K\$, or M\$)
M(anpower cost units=\$ (Either \$, K\$, or M\$)
F(ind critical path=yes

To change a project description data-field, press its letter
To quit making alterations, press "Q"

The data fields listed here are exactly the same as for the option titled "Names, Description, & Options". Please see that section of this manual for a detailed explanation of each field.

MENUS AND DISPLAYS

Load a different project into memory

Use this option to retrieve a project you have previously saved. It is up to you to remember the file name and the disk drive for each of your projects.

LOAD A DIFFERENT PROJECT

DISK FILE DATA:

F(file name=example1
D(isk drive=B

DISK FILE OPTIONS:

L(oad the project into memory
Q(uit and return to the MAIN OPTIONS

To change the file name or disk drive, press "F" or "D"
To quit and return to the MAIN OPTIONS, press "Q"
To load the project, press "L"

F(file name

To work on a different project, change the file name by pressing the letter "F" and entering a new file name. After the file is loaded, its name and a short summary is displayed for you to verify.

D(isk drive

To change the disk drive, press "D". Besides choosing a file name, you must to keep track of the disk drive where the file is stored. As shown in the screen above, the file named "example1" contains data for the water main project and resides on the "B" disk drive. (On UCSD PASCAL system, files are named with numbers like #4 and #5 or with seven character names.)

Modify The Project

There are four parts to the project information, the project name and description, the skill categories, the working hours, and the time schedule. The first three are data items that apply to the entire project, whereas, the job descriptions are details that describe each step.

Since the four sets of data are distinct, you are given access to them through different options.

MODIFY OR DISPLAY THE PROJECT

PROJECT DATA GROUPS:

N(ame, description, & options
M(anpower skills & costs
W(orking days, hours, and holidays
T(ime schedule

To modify or display the project, press "N", "M", "W", or "T"
To quit and return to the MAIN OPTIONS, press "Q"

N(ame, description, & options

This data group includes the project name, the name of the project leader, the start date, etc. Details about this data group are listed in a later section of the manual.

M(anpower skills & costs

If you want to keep track of manpower for you project, then you should make use of the skill categories. They are up to nine different manpower classifications and their corresponding rates of pay.

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W(orking days, hours, & holidays

If your project uses a time scale of HOURS or DAYS then you should make use of this option. It gives you the opportunity to define your normal working hours, working days, and holidays. Don't bother to setup this data if your project's time scale is weeks, months, or quarters.

T(ime schedule

This is the heart of MILESTONE. Under this option you enter job data and view the time schedule on the screen.

Name, Description, & Options

These are the first items you should enter when defining a new project.

NAME, DESCRIPTION, & OPTIONS

N(ame of project=First Street Water Main
L(eader of project=J. K. Henderson
 T(ime scale=Weeks (Hours, Days, Weeks, Months, Quarters, Fiscal)
 S(tart date=1/1/81 (Thu Jan 1)
D(irect cost units=K\$ (Either \$, K\$, or M\$)
M(anpower cost units=\$ (Either \$, K\$, or M\$)
F(ind critical path=yes

To change a project description data-field, press its letter
To quit making alterations, press "Q"

N(ame of project

The project name appears on all printouts generated by MILESTONE and is the primary means of identifying a project. You may enter any string of forty or fewer characters.

L(eader of project

Every project has a leader and, as you know, they tend to be rather conceited types and never miss an opportunity to see their name in print. So here it is; you can use up to twenty-four characters; make sure you spell his/her name correctly.

If you are preparing the plan for someone else, don't worry, your name will still appear on all of the reports so that you get credit for your work.

T(ime scale

As shown to the right of the display, the time scale may take on several different values: hours, days, weeks, months, quarters, or fiscal quarters.

All job durations are an integral number of time units, so pick the time scale

MENUS AND DISPLAYS

that corresponds to the shortest job in your project. If some of the jobs are only one or two days in duration, then you should probably choose days as the time unit. However, if most jobs are many weeks long, you may choose weeks as the time scale and enter "day-long" jobs as zero weeks.

Before you choose a time scale, think carefully about how "closely" you are going to manage the project. If you plan to check its progress every week, then WEEKS is the proper time scale. Don't select a short time scale unless you really need to.

Your choice also determines how the time line is displayed across the time schedule graph. The table below illustrates each of the options.

TIME SCALE	TIME SCHEDULE EXAMPLE
HOURS	Thu Jan 1 8 9 10 11 12 1 2 3 4 0 1 2 3 4 5 6 7 8 Fri Jan 8 9 9 10
DAYS	Jan 1 2 3 4 5 6 7 8 9 10 11 0 1 2 3 4 5 6 7 8 9 10
WEEKS	Jan Feb Mar 6 13 20 27 3 10 17 24 2 9 16 0 1 2 3 4 5 6 7 8 9 10
MONTHS	1980 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov 0 1 2 3 4 5 6 7 8 9 10
QUARTERS	1980 1981 1982 Jan Apr Jul Oct Jan Apr Jul Oct Jan Apr Jul 0 1 2 3 4 5 6 7 8 9 10
FISCAL QUARTERS	FY80 FY81 FY82 Oct Jan Apr Jul Oct Jan Apr Jul Oct Jan Apr 0 1 2 3 4 5 6 7 8 9 10

Although the screen display is limited to eleven units of time, the entire duration of the project appears on the printed time schedule graph. This is done by printing the schedule in several vertical strips which you can attach to form a complete chart. See the section titled "P(rint summary reports".

The time scale is the most crucial data item - choose it carefully. If you

change the time scale, the individual job durations are not converted automatically and you will have to use the MODIFY option to change the durations of each job accordingly. MILESTONE does not automatically change the durations because there is no unambiguous transformation between all possible time scales.

S(tart date

The start date is the date when you expect the project to begin. It becomes the 0th time unit in the project. All dates are relative to the start date, not absolute.

After entering all the jobs, a project can be shifted in time by simply changing the start date.

D(irect cost units

Each job may have an associated direct cost. This is a one time capital or expense outlay that is independent of the duration of the job. For example, in the "First Street Water Main" project, "purchase the pipe" has a direct cost of 50K\$.

As is common practice when dealing with cost estimates, figures are expressed in units of thousands or millions with only a few significant digits. This data field specifies which units will be used.

Only four significant digits are printed by MILESTONE. This saves space in memory allowing room for a large number of jobs.

If you select K\$, then direct costs can have values from 1K\$ to 9999K\$. This means that direct cost of less than 1K\$ must either be ignored or rounded up to 1K\$. Likewise, direct costs of more than 9999K\$ must be spread over more than one job.

Use the table shown below to choose the cost units depending on the range of job costs you foresee.

COST RANGE	COST UNITS
Dollars	\$
Thousands	K\$
Millions	M\$

Don't worry about cost totals exceeding the range of the units you have selected, MILESTONE automatically adjusts the cost units when totals are printed.

If you change the cost units, you will have to change the job costs that you have already entered.

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M(anpower cost units

Each skill category has an associated manpower cost expressed as "cost units/work unit" where the work unit is determined from the time scale. So, choose the manpower cost units based upon the time scale that you have already chosen.

For example, a time scale of weeks results in a work unit of man-weeks. The work units are summarized in the table below.

Time scale	Work units
Hours	Man-Hours
Days	Man-Days
Weeks	Man-Weeks
Months	Man-Months
Quarters	Man-Months
Fiscal	Man-Months

Later, when you enter the details for each skill category, you will be asked to specify the corresponding manpower costs.

If you change the cost units, you will have to change the skill category costs that you have already entered.

F(ind critical path

Although MILESTONE is based upon critical path analysis, it is sometimes useful to disable this feature and just consider direct scheduling of jobs. If that's what you want, then set this data field to "no".

Manpower Skills & Costs

Each job description includes a capital cost and a manpower level. By specifying the unit cost for different classifications of manpower here, the total project cost can be computed.

MANPOWER SKILLS & COSTS

Description	Cost in \$/Man-Week
1(st skill category=Operating engineer	1000
2(nd skill category=Laborer	500
3(rd skill category=Welder	750
4(th skill category=Civil Engineer	1500
5(th skill category=	
6(th skill category=	
7(th skill category=	
8(th skill category=	
9(th skill category=	

To change a skill description, press its number

To change a skill cost, press its number and then press TAB

To quit editing the skill categories, press "Q"

To change a skill category, press its number. The cursor will jump to the first character of the description. To skip over to the cost, press TAB.

Manpower costs can be subdivided into as many as nine skill categories. Each category has a twenty-four character name and a cost per unit of time.

The manpower cost is entered as "cost units/work unit" where the work unit is determined from the time scale. See the section titled "Name, Description, & Options" for a complete explanation of the time scale and corresponding work units).

As with costs, MILESTONE keeps track of skill levels as integer units in the range 1 to 9999 - decimal points are not allowed. If you want to allocate fractions of a person to a job, then you can simply enter skill levels as tenths, or hundredths, of a person. If so, remember to enter the cost here for a tenth, or hundredth, or a person per time unit.

MENUS AND DISPLAYS

Working Hours, Days, and Holidays

These data-fields are used only if the time scale is set to HOURS or DAYS. For other time scales, they are ignored.

WORKING HOURS, DAYS, AND HOLIDAYS

WORKING HOURS:

```
B(egin work=8
S(tart lunch=12
F(inish lunch=12
E(nd work=17
```

WORKING DAYS:

```
D(ays of the week=MTWThF
```

HOLIDAYS:

```
H(oliday list=1/1/81 5/25/81 7/4/81 9/7/81 11/26/81 12/25/81
```

To change the working hours, press "B", "S", "F", or "E"
To change the working days, press "D"
To add or remove a holiday, press "H"
To quit and return to the MAIN OPTIONS, press "Q"

B(egin and E(nd work

These two values define when the normal working day begins and ends. They must be even hours as defined on a 24 hour clock. Follow the rules for entering integers rather than times. You can setup a twenty-four hour day with "B(egin work=0" and "E(nd work=23".

S(tart and F(inish lunch

These two values define when the lunch time begins and ends. If you don't want to consider time off for lunch, then set them both equal. As with normal working hours, they must be even hours as defined on a 24 hour clock

D(ays of the week

Not everyone is fortunate enough to work only five days a week. If you are one of the unlucky ones, you can use this option to redefine your working days.

To change these days, press "D" and follow the new instructions that are displayed at the bottom of the screen.

H(oliday list

You can define up to twelve holidays. When the project is first created, six of the most commonly observed holidays are listed: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day. You can customize this list by pressing the letter "H" and following the instructions on the screen.

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Time Schedule Display

The Project Time Schedule display is the most important part of MILESTONE because it graphically illustrates the progress of your project as a function of time. The screen display shown below is for the first example on your disk.

PROJECT SCHEDULE		Keys are ==/critical,—/normal,.../slack,:::/done											
		Jan				Feb				Mar			
Revision 1, 1/1/81		5	12	19	26	2	9	16	23	2	9	16	
Job (Room for 117 more)		0	1	2	3	4	5	6	7	8	9	10	
1 Purchase the pipe	O	----->	>										
2 Dig 1st part of trench	O	----->	>										
3 Purchase fittings	O	=====											
4 Lay 1st part of pipe						=====							
5 Dig 2nd part of trench						>----->	>						
6 Fill 1st part of trench										>----->	>		
7 Lay 2nd part of pipe										>=====			
8 Fill 2nd part of trench												>=====	
9 Repave street													>=====
10 Repair sidewalk										>----->	>		
11 Project completed													X

A(dd E(rase or I(nsert a job move U(p D(own L(eft R(ight or H(ome
M(odify or C(omplete a job O(ther options Q(uit
To select an option, press its letter; numbers can prefix a move

Interpreting the schedule

The project name is at the top of the display, followed by the revision number and today's date.

Next comes the time line mentioned earlier in the discussion on "Time scales". It shows time progressing from left to right across the screen with specific dates marked in every fifth column. In the example the time line begins with the first week, January 5th, and extends to the end of the tenth week, March 16th.

There is room for sixteen jobs on the screen - eleven are shown in the example. Although many more jobs may be included in a project, the size of the terminal screen limits your view to only sixteen at a time. However, by choosing the "move" options, you can view all parts of the schedule.

Arrows and other symbols

The arrows are coded to convey as much information as possible about each job. The left end of an arrow is called its tail, and the right end is its head.

- >====> A critical path job - It cannot be delayed without delaying the entire project.
- >-----> A non-critical, or normal, job - The tail of the arrow is aligned with the earliest start date and the head is aligned with the earliest finish date.
- >.....> Slack time for a non-critical job - The slack time is the length of the arrow in time units. A job can be delayed up to its total slack time without delaying the project. The head of the slack arrow is aligned with a job's latest finish date.
- O====> A job with no prerequisites - The job has been scheduled to start on a specific date.
- >====X A job with no successors - No other job names this one as a prerequisite. The last job in a project normally ends with an "X", but other jobs may end with X's if your project has multiple finishes.
- * A zero length job - Sometimes it is convenient to define a job with zero duration just to mark an important event.
- O A zero length job with no prerequisites - Most often this corresponds to an outside event.
- X A zero length job with no successors - Typically the completion date of a project

MENUS AND DISPLAYS

Determining prerequisites from arrows

The key to critical path analysis is the notion of a job's prerequisites. They are the other jobs that must be finished before a job can start. (This is sometimes called "finish/start" precedence notation).

To determine a job's prerequisites while viewing the time schedule on your terminal, you can press "M" for modify and then enter the job number. All job data is displayed at the bottom of the screen and you can read the prerequisite list. After looking at the data, you can leave the job unmodified by pressing ESC.

Although the prerequisites are not shown explicitly on the time schedule, a lot of information can be determined by looking at the alignment of arrow heads and tails. For example,

```
.....>
=====>
      >=====
```

The tail of a critical path job is always aligned with the heads of its prerequisites. In the example screen display (look two pages before this page), you can see that jobs 1, 2, and 3 are all prerequisites of job number 4.

Modifying the Time Schedule

A(dd a job

There are two ways to enter a new job into the time schedule, by adding or by inserting. They are identical except for the way in which prerequisites are handled.

The screen display lists the jobs in technological order, i.e. every job follows all of its prerequisites. Requiring jobs to be listed in this order, makes it impossible to create an endless loop, at the expense of limiting your control over the appearance of the time schedule.

When ever you are entering new jobs, remember the rule of ordering,

EVERY JOB MUST FOLLOW ITS PREREQUISITES

You can control where a new job is placed in the list by specifying its position to be before or after another job, as long as you don't violate the rule of ordering.

Job placement

When you select the "A(dd" or "I(nsert" options, a short menu appears at the bottom of the screen.

Job number x will be added before or after the job shown below.
J(ob number=y B(efore=No A(fter=Yes
To change its position, press "J"; to change before or after press "B" or "A"
To quit, press "J"; to continue, press RETURN

The value "x" in the first line is the job number of the entry that will be added. MILESTONE assigns these numbers automatically to insure that no number is inadvertently used for two different jobs.

The value "y" in the second line, tells where the new job is to be added. MILESTONE initializes this to the number of the last job you entered, making it easy to quickly add a series of jobs. To change it to a new value, press "J" and enter a new number.

Also on the second line are two options, "B(efore" and "A(fter", telling where the new job is to be added relative to job number "y". Of course, these two options are mutually exclusive. To pick the option you want, press either "B" or "A".

After you have set these three fields, press RETURN to continue.

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A(dd

Selecting "A(dd" initializes all job data fields* and sets the prerequisite list in one of two ways:

- Add x after y - The prerequisite list is set to y
- Add x before y - The prerequisite list is set equal to y's list

To see how this works, consider adding a new job between Jobs 1 and 2 in the simple list shown below:

INITIAL JOB LIST

1	O—>....>	Job 1 has no prerequisites
2	O=====>	Job 2 has no prerequisites
3	>====X	Job 3 has 1 & 2 as prerequisites

Adding after Job 2 initializes Job 4's prerequisites to Job 2.

LIST AFTER ADDING JOB 4 AFTER JOB 2

1	O—>....>	Job 1 has no prerequisites
2	O=====>	Job 2 has no prerequisites
4	>====X	Job 4 has 2 as a prerequisite
3	>====X	Job 3 has 1 & 2 as prerequisites

Adding before Job 3 initializes Job 4's prerequisites to 1 and 2.

LIST AFTER ADDING JOB 4 BEFORE JOB 3

1	O—>....>	Job 1 has no prerequisites
2	O=====>	Job 2 has no prerequisites
4	>====X	Job 4 has 1 & 2 as prerequisites
3	>====X	Job 3 has 1 & 2 as prerequisites

For an explanation of all job data fields, read the section titled "Job Description".

*) If you have just erased a job, the data fields are left unchanged. This allows you to move a job by erasing and then adding, without having to reenter all of the data.

I(nsert

The "I(nsert" option is just like "A(dd" except the new job is insert into the job sequence, not just into a list position. Here's how it works,

Insert x after y - The prerequisite list is set to y, and all other jobs that name y as a prerequisite are changed to name x instead

Insert x before y - The prerequisite list is set equal to y's list and y is changed so that x is its only prerequisite

To see how this works, consider inserting a new job between Jobs 1 and 2:

INITIAL JOB LIST

1	O—>....>	Job 1 has no prerequisites
2	O=====>	Job 2 has no prerequisites
3	>====X	Job 3 has 1 & 2 as prerequisites

LIST AFTER INSERTING JOB 4 AFTER JOB 2

1	O—>.....>	Job 1 has no prerequisites
2	O=====>	Job 2 has no prerequisites
4	>====>	Job 4 has 2 as a prerequisite
3	>====X	Job 3 has 1 & 4 as prerequisites

LIST AFTER INSERTING JOB 4 BEFORE JOB 3

1	O—>....>	Job 1 has no prerequisites
2	O=====>	Job 2 has no prerequisites
4	>====>	Job 4 has 1 & 2 as prerequisites
3	>====>	Job 3 has 4 as a prerequisite

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E(rase a job

The "E(rase" option removes a job from the list and changes all other jobs prerequisites accordingly. First you are asked to enter the job number you wish to erase.

To erase a job, enter its number then press RETURN -->

If you change your mind at this point, press ESC and you will return to the modify options. If you enter a job number, you are asked to confirm your selection.

Is this the job you want to erase?
Job number=1 Job name=Purchase the pipe
Enter "Y" or "N"

If you answer "Y" for yes, the job is removed and the project schedule is readjusted.

M(odify a job

If you want to change any of a job's data fields, then you must select the "M(odify" option. First, you must specify which job you want to change.

To modify a job, enter its number then press RETURN -->

If the job exists, its data fields are displayed at the bottom of the screen.

```
N(ame=Purchase the pipe          D(uration=2          C(ost=50
P(rerequisites=0                  E(arly start=0
Skills 1(=0    2(=0    3(=0    4(=0    5(=0    6(=0    7(=0    8(=0    9(=0
To enter a field, press its key; to quit, press ESC; to use, press RETURN
```

To modify a data field, press the first letter of its name. The cursor will jump up to the first data character ready for a new value to be entered. For a thorough discussion of each item, read the section titled "Job Description".

MENUS AND DISPLAYS

C(omplete a job

By marking jobs as completed, you can keep track of your project's progress. Periodically read in your project file and complete those jobs which have been finished, then print out a new set of reports.

After picking the "C(omplete" option, enter the job number.

To complete a job, enter its number then press RETURN —>

If the job is found, you are asked to verify your choice.

Is this the job you want to complete?
Job number=1 Job name=Purchase the pipe
Enter "Y" or "N"

The job's prerequisites are checked to make sure they have all been completed. If they are not completed, you will not be allowed to complete this job. If you want to mark it as completed anyway, first use the modify option to set change its prerequisites, then rerun the complete option.

If it is legal to complete the job, you are asked to enter its actual completion date.

A(ctual completion date=2
To change the actual completion date, enter a new number
To quit with no change, press ESC; to leave as shown, press RETURN

The actual completion date is initialized to the value of the earliest finish date, but you can change it to anything you want.

To **uncomplete** a job, select the complete option. MILESTONE will detect that the job has already been completed and ask if you want to uncomplete it.

move U(p, D(own, L(ef, R(ight, or H(ome

As mentioned earlier in this chapter, a project may have many jobs, but only sixteen can be displayed on the screen at one time. These five options (up, down, left, right, and home) permit you to move around on the project schedule and view any sixteen consecutive jobs.

You can jump by typing in a number and then pressing a move key!

The screen display is like a window. Imagine that there is a "little man" inside your terminal holding a large piece of paper for you to see. You can view any part of that imaginary paper by commanding that "little man" to move the paper in a specific direction. By moving it up, down, left or right you can see any part of the schedule.

To move the window up or down one job, press the letter "U" or "D". If you want to move more than one job, type a number before you press "U" or "D". For example, to move down five jobs, press "5D".

To move the window left or right one time unit (i.e. one week if the time scale is in weeks), press "L" or "R". If you want to move more than one time unit, press a number before you press "L" or "R". For example, to move right twelve weeks, press "12R".

To view a specific job, enter its number and then press "H" for home. For example, to redisplay the schedule with job number ten at the top, press the digits "1" and "0", then press "H".

MENUS AND DISPLAYS

O(ther options

There are several other options that affect how the project schedule is displayed. Rather than listing them all at the bottom of the screen, they are displayed only if you press "O".

R(enumerate all jobs	show E(ffort summary	O(ther options
S(ort jobs into time order	show C(ost summary	Q(uit
To select an option, press its letter; to see other options, press "O"		

E(ffort summary

If the effort summary option is selected, then an extra line appears at the bottom of the screen showing the effort level versus time.

Manpower level=4	4	4	6	6	9	6	4	3	3	0
------------------	---	---	---	---	---	---	---	---	---	---

If your project is short on manpower, you may wish to have the manpower level displayed along with the schedule while you are entering or modifying job data. By glancing at the summary you can see immediately if you have exceeded your project's manpower allocation. You can then readjust the job sequence or effort level so as not to exceed your allocation.

To see an individual skill level, press a number from 1 to 9. For example, if EXAMPLE1 is loaded in memory, pressing "1" (while viewing the "Other Options" with the effort summary displayed) shows the manpower level for the first skill category, Operating Engineer.

Operating Engineer=1	1	1	0	0	1	0	2	3	3	0
----------------------	---	---	---	---	---	---	---	---	---	---

To see any other skill, press its number. To see the total for all skills, press "0".

To erase the effort summary, press "E" again.

C(ost summary

Selection of the cost summary option adds two more lines to the bottom of the display, the manpower cost and the direct cost. Each column is summed over all jobs aligned above it.

Manpower cost in K\$=2	2	2	3	3	5	3	3	3	3	0
Direct cost in K\$=75	0	5	13	0	10	5	10	30	0	0

As mentioned under "Project Description", two types of cost are involved in any project, direct costs (i.e. capital/expense) and manpower costs. The cost summary displays the direct cost as they are incurred at the beginning of a each job.

Here's how the project schedule would look if both the effort and cost summaries were selected. Notice in the example below that the first digit of each amount is aligned with the first digit of a time number and date. This alignment shows the cost/time correspondence.

PROJECT SCHEDULE		Keys are ==/critical,--/normal,.../slack,:::/done											
		Jan				Feb				Mar			
Revision 10, 6/26/81		1	8	15	22	29	5	12	19	26	5	12	
Job (Room for 117 more)		0	1	2	3	4	5	6	7	8	9	10	
1 Purchase the pipe	O----->....>												
2 Dig 1st part of trench	O----->....>												
3 Purchase fittings	O=====>												
4 Lay 1st part of pipe						>=====>							
5 Dig 2nd part of trench					>----->.....>								
6 Fill 1st part of trench								>----->....>					
7 Lay 2nd part of pipe								>=====>					
8 Fill 2nd part of trench										>=====>			
9 Repave street											>=====>		
10 Repair sidewalk									>----->.....>				
11 Project completed												X	
Manpower level=4		4	4	6	6	9	6	4	3	3	0	0	
Manpower cost in K\$=2		2	2	3	3	5	3	3	3	3	0	0	
Direct cost in K\$=75		0	5	13	0	10	5	10	30	0	0	0	
A(dd E(rase or I(nsert a job move U(p D(own L(eft R(ight or H(ome													
M(odify or C(omplete a job O(ther options Q(uit													
To select an option, press its letter; numbers can prefix a move													

R(enumerate all jobs

The job numbers appearing to the left of the job name are assigned by MILESTONE. After a long session of erasing, adding, and inserting these numbers may no longer be in ascending order. For cosmetic reasons you may wish to renumber them.

WARNING! Renumbering is an irreversible process. If you want to keep a set of numbers, don't ever select the renumber option.

MENUS AND DISPLAYS

Sort jobs into time order

This is another cosmetic option that may improve the appearance of the display. It results in a time schedule with arrow heads further to the right as you move down the list. The jobs are sorted into the following order:

Primary key = Increasing late finish time
Secondary key = Decreasing early start time
Tertiary key = Decreasing late start

WARNING! Sorting is an irreversible process. If you want to keep a specific ordering, don't ever select the sort option.

Job Description

MILESTONE treats a project as a collection of jobs (or activities) that must be completed in a specified sequence. This is the only rational way to plan a complex project; it's too difficult to grasp the intricacies of a complex project without breaking it down into smaller easily understood jobs.

A job should be a well defined activity for which you can devise confident duration, cost, and effort estimates. If you have a high confidence each each job estimate, then you will have a high confidence in the complete project schedule.

The project schedule is determined by linking jobs together in time according to how they depend upon each other. This dependence is determined by specifying which other jobs must be completed before any one job may be started. These other jobs are called "prerequisites", otherwise known as finish/start precedence.

A prerequisite is another job that must be done first. In the water main example project the trench shouldn't be filled until after the pipe has been tested for leaks; therefore testing for leaks is a prerequisite to filling the trench. On the other hand, purchasing the pipe has no prerequisites and can begin as soon as the project is given the go-ahead.

Whenever you select "A(dd, I(nsert, or M(odify" a job, a job description menu is displayed at the bottom of the screen. This menu lists all of the data fields necessary to completely define a job.

Look below at the two sample menus to see the job descriptions for the two parts of "digging the trench" in the water main project. "Digging the first part" has no prerequisites and can begin immediately. However, "digging the last part" can only begin after digging the first part is completed.

N(ame=Dig 1st part of trench	D(uration=2	C(ost=0
P(rerequisites=0	E(arly start=0	
Skills 1(=1	2(=3	3(=0
4(=0	5(=0	6(=0
7(=0	8(=0	9(=0
To enter a field, press its key; to use as is, press RETURN		

Remember, the data fields are in order from left-to-right and top-to-bottom, i.e. N(ame, D(uration, C(ost, P(rerequisites, etc.

To move to the next field, press TAB

To move to the previous field, press BACKSPACE

To quit at any time with no changes, press ESC

To enter the job with all fields as shown, press RETURN

The menu above shows the data fields necessary to completely describe a job that has no prerequisites. Since the number of prerequisites is zero, the start date is shown as a data field. If number of prerequisites listed is not zero, then a slightly different display is shown.

MENUS AND DISPLAYS

N(ame=Dig 2nd part of trench	D(uration=1	C(ost=5
P(rerequisites=2		
Skills 1(=1	2(=3	3(=0
4(=0	5(=0	6(=0
7(=0	8(=0	9(=0
To enter a field, press its key; to use as is, press RETURN		

N(ame

A job name can be up to thirty characters long and should accurately describe the activity. Looking back at the project schedule you can see that there is only room for twenty characters. Only as much of the name as will fit is actually displayed.

D(uration

The duration is the number of time units necessary to complete the job.

For some jobs the duration may be related to the effort level, i.e. more workers can do the job in a shorter time. It is up to you to choose a combination of duration and effort best suited to your working conditions. At a later time you may change the combination and see the resulting effect on the overall project schedule.

Other jobs may have a duration that is completely independent of the effort level. For example, after pouring structural concrete twenty-eight days must elapse before it reaches full strength. Such a job could be shown as a four week duration and zero effort.

Fractional durations are not allowed. If you find it necessary to have a duration such as 1.5 weeks, perhaps you should use a time scale of days instead.

P(rerequisites

A job "with no prerequisites" is defined by setting the number of prerequisites to zero and then specifying a time for the earliest possible start. For example, "Dig 1st part of trench" has no prerequisites and can begin as soon as the project begins.

A job "with prerequisites" is defined by entering the numbers of the jobs which must be completed first. In the water main example, "Dig 2nd part of trench" cannot begin until after "Dig 1st part of trench" is completed.

A job cannot have more than nine prerequisites. If a job depends on more than nine others, consider creating two other fictitious jobs of zero duration. Each of these fictitious jobs could depend on up to nine others and one job depending on both of them could, in effect, depend on up to eighteen.

E(arly start

You must enter this date only if you have specified zero prerequisites.

When you add a new job, the start date is automatically set to the project start date (i.e. the 0th time unit). If the project start date is ever changed, then all jobs with no prerequisites are automatically rescheduled. See the discussion of time scales in the section titled "Name, Description, & Options".

Skills 1(to 9(

Each job can draw manpower from any combination of the nine different skills. In the "water main" example, three laborers (skill category number 2) and one operating engineer (skill category number 1) are needed to dig the trench.

Each skill is indicated by the skill number, "1(=", and a manpower level. To change the manpower for a given skill, press the key for the corresponding skill number and then enter the manpower level.

To make MILESTONE fast and interactive it was necessary to restrict manpower levels to even integers. If your application requires fractional levels of manpower, consider inputting the levels as if they were tenths of a person. For example, use a level of "15" for one and a half people instead of "1.5". If you setup the costs for the skill categories accordingly, this method will work fine. Just remember to interpret the totals as tenths when reading the manpower reports.

After you have entered the manpower level, press TAB to go to the next skill category or press RETURN to leave the remaining categories as they are shown.

Don't confuse the manpower level with the total effort. The manpower level level is the number of people working on a job; the total effort is the product of the manpower level and duration. For example an manpower level of four men working for a duration of four weeks results in sixteen man-weeks of total effort.

MENUS AND DISPLAYS

Print a Summary Report

MILESTONE provides several different report formats, each one designed to give you quick access to information about your project. Subsequent revisions of MILESTONE may have more reports than are listed here.

PRINT A SUMMARY REPORT

REPORTS THAT CAN BE PREVIEWED ON THE TERMINAL:

- P(roject description report
- J(ob description report
- C(olumnar job report

REPORTS THAT ARE SENT DIRECTLY TO THE PRINTER:

- T(ime schedule report
- A(ll of the above reports

OTHER OPTIONS:

- M(odify the printout parameters
- Q(uit and return to main options

To printout a report, press its letter, "P", "J" etc.
To return to the main menu, press "Q"

A report can be previewed by displaying it directly on the screen rather than sending it to the printer. If you select one of the "previewable" reports, you will be asked if you want to see it on the screen first.

P(roject description report

This is a one page summary of the entire project (see page A-1). It lists all of the general information about the project along with pertinent manpower and cost totals. Its purpose is to provide a concise summary of a projects resource needs.

J(ob description report

This is an exhaustive summary of the details for each job in a project (see page A-2). It is printed in a "paragraph" style format for easy reading. Because it is so lengthy, you will probably use the columnar report most of the time and generate this report at less frequent intervals.

This length can be limited by setting the first and last job numbers under the "M(odify printout parameters" option.

C(olumnar job report

This columnar report prints the job description information as a table, rather than paragraphs, resulting in a compact report. You can customize it to suit your needs by including or excluding different data fields. (See the sample reports on pages A-10 through A-13.)

COLUMNAR JOB REPORT

COLUMN NAME	WIDTH
J(ob number=Yes	5
N(ame=No	
D(uration=Yes	20
E(arly times=Yes	20
L(ate times=Yes	20
S(lack=Yes	10
C(osts=No	
P(rerequisites=No	
M(anpower=No	
	75 columns/80 max
U(se page headings=Yes	

OPTIONS:

B(egin printing
Q(uit and return to the report options

To include or remove a column, press its letter
To return to the report options, press "Q"
To begin printing, press "B"

You select from nine possible report columns as long as the total width of the report does not exceed the width of your printer (You can change the printer width with the "M(odify printout" option). Each column is described in the following table.

NAME	WIDTH	EXPLANATION
Job number	5	
Name	30	
Duration	20	Number of time units and completed status
Early times	20	Early start and finish in integer time units
Late times	20	Late start and finish in integer time units
Slack	10	Number of time units
Costs	20	Total manpower and direct costs
Prerequisites	40	Job numbers in the prerequisite list
Manpower	40	Number in each of the nine skill categories
	205	Maximum possible report width

Although the times are shown as integer numbers, you can use this report in conjunction with the Time Schedule Graph to determine the actual dates.

MENUS AND DISPLAYS

To use this report as input to a program other than MILESTONE, set the "Use page headings" option to "NO" and set the output device name to a disk file name. This will strip the column titles, blank lines, and form feeds from the report so that it can be more easily input to another program. The resulting format is ASCII with fixed width columns as noted in the preceding table.

T(ime schedule graph

The time schedule graph is a printed image of the entire time schedule like the screen display.

As you know by now, a project may consist of one hundred or more jobs over a long time span. The problem is "How can you print such a big schedule on such a narrow strip of printer paper".

We think we have come up with a unique solution. The time schedule is printed in a series of strips. To make a large chart, you can simply tape the strips together. For example, looking at the schedule in Appendix B, you see that it is on two sheets of paper that can be aligned to form one larger sheet.

There is no practical limit to the size chart that can be produced by printing separate strips in this manner.

If you have a wide printer, be sure to set its width accordingly. Some printers can print 132 or more columns on one sheet of paper. You can change the report width under the "M(odify printout options" or permanently with the CONFIG program. By changing it under the printout option, you can use 132 column paper for the time schedule and 80 column paper for the other reports.

A(11 of the above reports

This option is provided for those of you who don't like to sit around watching printers clunk away. Just press the letter "A" and go out for a cup of coffee. When you return, you will have a neat little stack of paper with all of the pertinent reports (barring some unforeseen printer hangup).

MENUS AND DISPLAYS

M(odify the printout parameters

The printout parameters govern how output reports are to be printed. Some of them depend upon the physical characteristics of your printer, others depend upon how you want reports to be formatted.

PRINTOUT PARAMETERS

```
D(evice name=printer:
W(idth in columns=80
  F(irst job=1
    L(ast job=11
      S(ingle sheets=No
```

To change a variable, press its letter
To quit with no changes, press ESC
To return to the PRINTOUT options, press "Q"

D(evice name

Normally you will direct the printout to your printer (it's called "printer:" by PASCAL/M programs, not "lst:"); however, by changing the device name you can redirect the output to a disk file or any other device. Although legal device names on CP/M systems are limited to "printer:", "punch:" and "null:", you can could direct the output to a different device by using the STAT command.

To send your output to a disk file, change the device name to a file name like "REPORT.TEX". At a later time, you can insert the report directly into another document using a word processing program.

If the disk file already exists, it will be left unchanged and the report will not be output. Therefore, if you want to send more than one MILESTONE report to a disk file, you must change the Device name each time. Likewise, if you select "A(11 of the reports", only the first one will appear in the disk file. (MILESTONE behaves this way because the PASCAL language does not allow a program to append text to a sequential file.)

W(idth in columns

You can use a printer of any width. Most printers print a ten characters per inch on paper either eighty or one hundred thirty-two columns wide. Others can print at twelve or sixteen and a half characters per inch. Although most reports use only eighty columns, the Columnar Job Report and the Time Schedule Graph can use up to 255 columns.

If the Time Schedule Graph comes out double spaced on your printer, you should change the width to 79 columns. Some printers perform an automatic linefeed when an eighty column line is printed, causing a double linefeed when MILESTONE subsequently sends the carriage return and linefeed.

F(irst & L(ast jobs

To shorten the length of the MILESTONE reports, you can set these two numbers. Only the jobs from the first to the last will be printed. This is especially useful for the Job Description Report and the Time Schedule Graph because it lets you printout a subset of the entire project.

S(ingle sheets

If you intend to use single sheets of paper in your printer, then you must have this option set to "YES", so that the program will stop at the end of each page ready for you to insert another single sheet.

There are two ways to load single sheets into your printer: so that the print element is ready to print on the very first line of the sheet, or rolled up one inch (and held against the platten by the pressure bail) so that the element is ready to print on the seventh line of the sheet. If you intend to roll the paper up one inch, then you must rerun the CONFIG program and change the top margin to 0 and the paper length to 60 lines.

MENUS AND DISPLAYS

Save a Project on Disk

After you have create a new project or modified an old one, use this option to save your work.

SAVE THE CURRENT PROJECT

DISK FILE DATA:

F(file name=example1
D(isk drive=B

DISK FILE OPTIONS:

S(ave the project on disk
Q(uit and return to the MAIN OPTIONS

To change the file name or disk drive, press "F" or "D"
To quit and return to the MAIN OPTIONS, press "Q"
To save the project, press "S"

F(file name

All project data is kept in two disk files. It is up to you to choose a file name and to keep track of the disk drive. As shown in the screen above, the file named "example1" contains data for the water main project. The file "example1.des" contains the project description data and "example1.job" contains the details of all jobs.

If you create a new project, then before you save it on disk you will have to invent a new file name. It is good practice to invent a name that has a meaning relative to the project so that you can remember what it contains. But be careful of duplicate file names you may get confused and accidentally destroy a file.

Never change diskettes while running MILESTONE. If your read or write on a disk drive, change diskettes, and then try to save a file on that drive, you will get the error message "BDOS ERROR ON x READ ONLY". Since there is no way to recover from this error, you may loose all of your work.

D(isk drive

Besides choosing a file name, you must to keep track of the disk drive where the file is stored. As shown in the screen above, the file named "example1" contains data for the water main project and resides on the "B" disk drive. (On UCSD PASCAL system, files are named with numbers like #4 and #5 or with seven chracter names.)

ERROR EXPLANATIONS

Error Messages

Although MILESTONE contains a comprehensive set of checks on each individual key that you press (bad keys causing a bell), some errors are impossible to detect until after you have made a complete data entry. These errors are listed below with some remarks that may help you.

ERROR # 1 - The time scale is limited to: Hours, Days, Weeks, Months, Quarters, and Fiscal Quarters. If you try to enter some other value, it will cause an error.

ERROR # 2 - The cost units are limited to one of the following values: \$, K\$, and M\$. Thousands are denoted by "K" and millions by "M".

ERROR # 3 - You must enter either "Yes" or "No". All other entries will cause an error.

ERROR # 4 - You cannot enter the number of a job that does not exist. Perhaps you have either renumbered the jobs or have erased one.

ERROR # 5 - A fundamental requirement is that a job's prerequisites must precede it. This also implies that a job cannot name itself as a prerequisite. It would create a paradox, if a job could not start until it finished.

ERROR # 6 - As mentioned in number 5 above, a job's prerequisites must precede it. If this error is preventing you from modifying a job's prerequisites, first erase it and then use the I(nsert option to back into the list where it belongs.

ERROR # 7 - You cannot modify or display a job unless it is first loaded into memory.

ERROR # 8 - Another fundamental requirement is that no job can have more than nine prerequisites. If you encounter this error, you have tried to erase a job and MILESTONE's attempt to correct all jobs that depend upon it would result in the named job having more than nine prerequisites. The solution to this dilemma is to manually modify the prerequisites of the named job.

ERROR # 9 - Before you run MILESTONE, you must first run the program named CONFIG in order to create the file named "terminal.dat". This file contains all information needed to control your terminal and printer. If you have already run CONFIG, then check to make sure that you are logged on to the disk drive with the file "terminal.dat". On CP/M system you log onto a disk drive by entering its letter and then pressing RETURN. On UCSD PASCAL and APPLE PASCAL systems you log onto a disk by executing the FILER and setting the PREFIX the the disk's name or number.

ERROR #10 - This error occurs if you try to enter a time that is out of order. For example, the time that you end work must be after the time that you start work.

ERROR #11 - When defining your normal working days, you must have at least one.

ERROR EXPLANATIONS

Hey, if you don't work at least one day a week, why are you running this program.

ERROR #12 - The working day must be at least one hour long. We have yet to find a place of business that works less than one hour per working day. If you do, please send us a stack of job applications.

ERROR #13 - The number of holidays is limited to twelve. This arbitrary limitation is necessary in order to conserve memory space. If you think you need more than twelve perhaps you can get by by defining the twelve that immediately follow the project start date. If you want to block off a period of time for vacation, then simply define a job that has no prerequisites and begins when your vacation begins. Then you can have other jobs name your vacation as a prerequisite.

ERROR #14 - There is not enough room in memory to hold another job. Solution, buy more memory. If you only need a couple of more jobs, consider reducing the number by combining several together. If you need a lot more, then divide you project into phases and treat them as separate projects.

ERROR #15 - A prerequisite list must be made up of up to nine numbers separated by commas. Each number can be up to three digits long.

ERROR #16 - A job cannot be completed until all of its prerequisites are completed. Trying to complete a job before its prerequisites are finished contradicts the definition of a prerequisite. If the job is really completed, then correct its prerequisite list before marking it completed.

ERROR #17 - Can't uncomplete a job if one of its successors is completed. This is the reverse situation as error #16. First, uncompleted the successor job, then uncomplete this one.

ERROR #18 - Can't insert an uncompleted job into a sequence of completed jobs. This prevents you from ever creating a situation where a completed job's prerequisite is uncompleted.

Warning Messages

Warnings are not really errors, but rather messages to alert you that the action you are about to take may cause loss of data. A bell rings, the warning message is displayed, and you are asked to confirm you action.

WARNING # 1 - Since you have not yet saved the project that is in memory, the action you are about to take will cause it to be erased. If you want to save it first, answer "NO". If you want to create a new project anyway, then answer "YES".

WARNING # 2 - There is no need to save the project since it has not been changed. This warning might appear if you are confused about what you are doing.

WARNING # 3 - Since you have not yet saved the project that is in memory, the

ERROR EXPLANATIONS

action you are about to take will cause it to be erased. If you want to save it first, answer "NO". If you want to load a different new project anyway, then answer "YES".

WARNING # 4 - Since you have not yet saved the project that is in memory, quitting MILESTONE take will cause it to be erased. If you want to save it first, answer "NO". If you want to quit anyway, then answer "YES".

System Error Messages

The phrase "System Error Messages" refers to those errors that are outside of MILESTONE's control. If you encounter one of these errors, it is probably due to an electronic hardware error, a problem with your disk media, or simply confusion on your part about disk drives and file names. The following paragraphs attempt to help you fix the problem.

SYSTEM ERROR # 1 - Hardware error when reading. Probably a bad disk.

SYSTEM ERROR # 2 - Unknown device specified. Probably an incorrect disk drive name when loading or saving a file.

SYSTEM ERROR # 3 - Illegal operation. You should not get this error.

SYSTEM ERROR # 4 - Undefined hardware error. Call your computer dealer, there is something wrong with your disk controller.

SYSTEM ERROR # 5 - Device referenced is not on line. Most likely an incorrect disk drive name when loading or saving a file. It could also be due to an incorrect name for the printer device - Try running CONFIG again.

SYSTEM ERROR # 6 - File is no longer in directory. You probably put a new disk in a drive while running MILESTONE. That is a NO-NO.

SYSTEM ERROR # 7 - Illegal file name. Most likely an invalid character imbedded inside a file name. Consult your system manual for rules about file names.

SYSTEM ERROR # 8 - Insufficient space on disk. Try saving your file on a different drive that may have some space left.

SYSTEM ERROR # 9 - No such volume on line. Most likely a bad disk name.

SYSTEM ERROR #10 - File not found on device specified. Double check the file name and disk drive. The project description report, if you have printed one, has this information.

SYSTEM ERROR #11 - Duplicate file. The named file already exists.

SYSTEM ERROR #12 - File already open. You should not encounter this error.

SYSTEM ERROR #13 - File is not open. You should not encounter this error.

SYSTEM ERROR #14 - Error in reading real or integer. Most likely you are trying to read a file that was not created by MILESTONE.

SYSTEM ERROR #15 - File position error. You should not get this error.

SYSTEM ERROR #16 - End of file found when reading. Probably trying to read a file not created by MILESTONE or a file that has been copied incorrectly.

SYSTEM ERROR #17 - No more room in memory. You are trying to load a project with too many jobs. This only happens if the project was created on a different computer with more memory, or if you have taken some memory out of your computer. If you continue, you will notice that memory was filled with as much of the project as possible.

SYSTEM ERROR #18 - Project files have not been updated. The file formats changed between Milestone revision 1.07 and 1.08. To read old project files, you must first update them by running the program named UPDATE.

Other Error Messages

BDOS ERROR ON x SELECT - The disk drive has either been turned off or the disk has been removed. There is no recovery from this error.

BDOS ERROR ON x READ ONLY - You have changed disks while MILESTONE was running. There is no recovery from this error.

Pcode file not found. Pascal/M ABORT. - Either you typed the program name in wrong or you are logged onto the wrong disk drive.

Pcode file ill-formed. Pascal/M ABORT. - Either you are trying to execute a file that is not a Pascal/M program or somehow you have clobbered the program file. If so, recopy the program from you master disk.

String length exceeds declared limit. - Somehow one of the MILESTONE data files has been clobbered. Sometimes this happens when files are copied incorrectly (i.e. by reading into memory with DDT and then saving onto a different disk drive). To make sure you copy files correctly, always use PIP.

APPENDIX A: SAMPLE REPORTS

PROJECT DESCRIPTION REPORT

First Street Water Main
Revision 10, 6/26/81
Prepared by Mike Posehn

DESCRIPTION DATA FIELDS:

Name of project=First Street Water Main
Leader of project=J. K. Henderson
Time scale=Weeks
Start date=1/5/81
Direct cost units=K\$
Manpower cost units=\$
Find critical path=Yes
File drive and name=A:example1

SKILL CATEGORIES:

Description	\$/Man-Week	Man-Weeks	Total Cost
1st skill category=Operating Engineer	1000	12	\$12K
2nd skill category=Laborer	500	29	\$14K
3rd skill category=Welder	750	8	\$6K
4th skill category=Civil Engineer	1500	0	\$0
5th skill category=	0	0	\$0
6th skill category=	0	0	\$0
7th skill category=	0	0	\$0
8th skill category=	0	0	\$0
9th skill category=	0	0	\$0

WORKING HOURS:

Begin work=8
Start lunch=12
Finish lunch=12
End work=17

WORKING DAYS:

Days of the week=MTuWThF

HOLIDAYS:

Holiday list=1/1/81 5/25/81 7/4/81 9/7/81 11/26/81 12/25/81

SCHEDULE SUMMARY:

Completion date=3/16/81
Number of jobs=11
Total manpower=49 Man-Weeks
Manpower cost=\$32500
Direct cost=\$148000
Total cost=\$180500

SAMPLE REPORTS

JOB DESCRIPTION REPORT

First Street Water Main
Revision 10, 6/26/81
Prepared by Mike Posehn

Job #1, Purchase the pipe

Duration=2 Weeks	Earliest start=1/5/81
Completed=No	Earliest finish=1/19/81
On critical path=No	Latest start=1/12/81
Slack time=1 Week	Latest finish=1/26/81
Prerequisites=none	
Manpower skills=none	
Total effort=none	
Manpower cost=\$0	
Direct cost=\$50000	

Job #2, Dig 1st part of trench

Duration=2 Weeks	Earliest start=1/5/81
Completed=No	Earliest finish=1/19/81
On critical path=No	Latest start=1/12/81
Slack time=1 Week	Latest finish=1/26/81
Prerequisites=none	
Manpower skills=Skill #1, Operating Engineer, 1 @ 1000\$ per Man-Week	
Skill #2, Laborer, 3 @ 500\$ per Man-Week	
Total effort=8 Man-Weeks	
Manpower cost=\$5000	
Direct cost=\$0	

First Street Water Main
Revision 10, 6/26/81

Job #3, Purchase fittings

***** CRITICAL *****

Duration=3 Weeks
Completed=No
On critical path=Yes
Slack time=none

Earliest start=1/5/81
Earliest finish=1/26/81
Latest start=1/5/81
Latest finish=1/26/81

Prerequisites=none

Manpower skills=none

Total effort=none
Manpower cost=\$0
Direct cost=\$25000

Job #4, Lay 1st part of pipe

***** CRITICAL *****

Duration=2 Weeks
Completed=No
On critical path=Yes
Slack time=none

Earliest start=1/26/81
Earliest finish=2/9/81
Latest start=1/26/81
Latest finish=2/9/81

Prerequisites=Job #1, Purchase the pipe
Job #2, Dig 1st part of trench
Job #3, Purchase fittings

Manpower skills=Skill #2, Laborer, 4 @ 500\$ per Man-Week
Skill #3, Welder, 2 @ 750\$ per Man-Week

Total effort=12 Man-Weeks
Manpower cost=\$7000
Direct cost=\$13000

SAMPLE REPORTS

First Street Water Main
Revision 10, 6/26/81

Job #5, Dig 2nd part of trench

Duration=1 Week	Earliest start=1/19/81
Completed=No	Earliest finish=1/26/81
On critical path=No	Latest start=2/2/81
Slack time=2 Weeks	Latest finish=2/9/81

Prerequisites=Job #2, Dig 1st part of trench

Manpower skills=Skill #1, Operating Engineer, 1 @ 1000\$ per Man-Week
Skill #2, Laborer, 3 @ 500\$ per Man-Week

Total effort=4 Man-Weeks
Manpower cost=\$2500
Direct cost=\$5000

Job #6, Fill 1st part of trench

Duration=1 Week	Earliest start=2/9/81
Completed=No	Earliest finish=2/16/81
On critical path=No	Latest start=2/16/81
Slack time=1 Week	Latest finish=2/23/81

Prerequisites=Job #4, Lay 1st part of pipe

Manpower skills=Skill #1, Operating Engineer, 1 @ 1000\$ per Man-Week
Skill #2, Laborer, 2 @ 500\$ per Man-Week

Total effort=3 Man-Weeks
Manpower cost=\$2000
Direct cost=\$10000

First Street Water Main
Revision 10, 6/26/81

Job #7, Lay 2nd part of pipe

***** CRITICAL *****

Duration=2 Weeks
Completed=No
On critical path=Yes
Slack time=none

Earliest start=2/9/81
Earliest finish=2/23/81
Latest start=2/9/81
Latest finish=2/23/81

Prerequisites=Job #5, Dig 2nd part of trench
Job #4, Lay 1st part of pipe

Manpower skills=Skill #2, Laborer, 4 @ 500\$ per Man-Week
Skill #3, Welder, 2 @ 750\$ per Man-Week

Total effort=12 Man-Weeks
Manpower cost=\$7000
Direct cost=\$0

Job #8, Fill 2nd part of trench

***** CRITICAL *****

Duration=1 Week
Completed=No
On critical path=Yes
Slack time=none

Earliest start=2/23/81
Earliest finish=3/2/81
Latest start=2/23/81
Latest finish=3/2/81

Prerequisites=Job #7, Lay 2nd part of pipe
Job #6, Fill 1st part of trench

Manpower skills=Skill #1, Operating Engineer, 2 @ 1000\$ per Man-Week
Skill #2, Laborer, 2 @ 500\$ per Man-Week

Total effort=4 Man-Weeks
Manpower cost=\$3000
Direct cost=\$10000

SAMPLE REPORTS

First Street Water Main
Revision 10, 6/26/81

Job #9, Repave street

***** CRITICAL *****

Duration=2 Weeks	Earliest start=3/2/81
Completed=No	Earliest finish=3/16/81
On critical path=Yes	Latest start=3/2/81
Slack time=none	Latest finish=3/16/81

Prerequisites=Job #8, Fill 2nd part of trench

Manpower skills=Skill #1, Operating Engineer, 3 @ 1000\$ per Man-Week

Total effort=6 Man-Weeks
Manpower cost=\$6000
Direct cost=\$30000

Job #10, Repair sidewalk

Duration=1 Week	Earliest start=2/16/81
Completed=No	Earliest finish=2/23/81
On critical path=No	Latest start=3/9/81
Slack time=3 Weeks	Latest finish=3/16/81

Prerequisites=Job #6, Fill 1st part of trench

Manpower skills=none

Total effort=none
Manpower cost=\$0
Direct cost=\$5000

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Job #11, Project completed

***** CRITICAL *****

Duration=0 Weeks
Completed=No
On critical path=Yes
Slack time=none

Earliest start=3/16/81
Earliest finish=3/16/81
Latest start=3/16/81
Latest finish=3/16/81

Prerequisites=Job #9, Repave street
Job #10, Repair sidewalk

Manpower skills=none

Total effort=none
Manpower cost=\$0
Direct cost=\$0

SAMPLE REPORTS

First Street Water Main, Revision 10, 6/26/81
Prepared by Mike Posehn

Job Description	Jan				Feb				Mar
	5	12	19	26	2	9	16	23	2
	0	1	2	3	4	5	6	7	8
1 Purchase the pipe	O----->....>				.	.	.	.	.
2 Dig 1st part of trench	O----->....>				.	.	.	.	.
3 Purchase fittings	O=====>				.	.	.	.	.
4 Lay 1st part of pipe	.	.	.	>=====>			.	.	.
5 Dig 2nd part of trench	.	.	>----->.....>				.	.	.
6 Fill 1st part of trench	.	.	.	.	.	>----->....>		.	.
7 Lay 2nd part of pipe	.	.	.	.	.	>=====>		.	.
8 Fill 2nd part of trench	.	.	.	.	.	.	.	>=====>	
9 Repave street	.	.	.	.	.	.	.	.	>=====
10 Repair sidewalk	.	.	.	.	.	.	>----->.....>		
11 Project completed	.	.	.	.	.	.	.	.	.
Operating Engineer=1		1	1	0	0	1	0	2	3
Laborer=3		3	3	4	4	6	4	2	0
Welder=0		0	0	2	2	2	2	0	0
Total manpower level=4		4	4	6	6	9	6	4	3
Manpower cost=2.5K	2.5K	2.5K	2.5K	3.5K	3.5K	5.5K	3.5K	3K	3K
Direct cost=75K	0	5K	13K	0	10K	5K	10K	30K	
Total cost=77K	2.5K	7.5K	16K	3.5K	15K	8.5K	13K	33K	

Symbol - Explanation
 >-----> Duration of a normal job
 >....> Slack time for a normal job
 >=====> Duration of a critical path job
 >::::> Duration of a completed job
 * Job with zero duration
 O-----> Job with no prerequisites
 >-----X Job with no successors

SAMPLE REPORTS

[illegible]

COLUMNAR JOB REPORT

First Street Water Main
Revision 10, 6/26/81
Prepared by Mike Posehn

JOB NAME	EARLY START	EARLY FINISH	LATE START	LATE FINISH
1 Purchase the pipe	0	2	1	3
2 Dig 1st part of trench	0	2	1	3
3 Purchase fittings	0	3	0	3
4 Lay 1st part of pipe	3	5	3	5
5 Dig 2nd part of trench	2	3	4	5
6 Fill 1st part of trench	5	6	6	7
7 Lay 2nd part of pipe	5	7	5	7
8 Fill 2nd part of trench	7	8	7	8
9 Repave street	8	10	8	10
10 Repair sidewalk	6	7	9	10
11 Project completed	10	10	10	10

COLUMNAR JOB REPORT

First Street Water Main
Revision 10, 6/26/81
Prepared by Mike Posehn

JOB NAME	DURATION	COMPLETE	SLACK TIME
1 Purchase the pipe	2	No	1
2 Dig 1st part of trench	2	No	1
3 Purchase fittings	3	No	0
4 Lay 1st part of pipe	2	No	0
5 Dig 2nd part of trench	1	No	2
6 Fill 1st part of trench	1	No	1
7 Lay 2nd part of pipe	2	No	0
8 Fill 2nd part of trench	1	No	0
9 Repave street	2	No	0
10 Repair sidewalk	1	No	3
11 Project completed	0	No	0

SAMPLE REPORTS

COLUMNAR JOB REPORT

First Street Water Main
Revision 10, 6/26/81
Prepared by Mike Posehn

JOB	SLACK TIME	DIRECT COST	MANPOWER COST	SKILL CATEGORIES	1	2	3	4	5	6	7	8	9
1	1	50000	0										
2	1	0	5000		1	3							
3	0	25000	0										
4	0	13000	7000			4	2						
5	2	5000	2500		1	3							
6	1	10000	2000		1	2							
7	0	0	7000			4	2						
8	0	10000	3000		2	2							
9	0	30000	6000		3								
10	3	5000	0										
11	0	0	0										

COLUMNAR JOB REPORT

First Street Water Main
Revision 10, 6/26/81
Prepared by Mike Posehn

JOB	PREREQUISITES								
	1	2	3	4	5	6	7	8	9
1									
2									
3									
4	1	2	3						
5	2								
6	4								
7	5	4							
8	7	6							
9	8								
10	6								
11	9	10							

APPENDIX B: TERMINAL CONTROL CODES

If your terminal does not appear in the "TERMINAL SELECTION" list, then you must manually enter its control codes. This will certainly require that you read and understand the technical manual for your terminal and may require the assistance of a programmer.

If you cannot find a programmer to help you, consult your computer dealer or software distributor.

After selecting the "terminal not shown" option in the "TERMINAL SELECTION" list, the following display appears.

TERMINAL SELECTION

Since your terminal is not shown on the menu, you must specify its control codes for cursor positioning, clearing the screen, and other functions. Please consult your terminal manual before continuing.

The mandatory control codes are,

- * Clear the screen and home the cursor
- * Position the cursor to a specific row and column

Optional control codes are,

- * Erase from the cursor to the end of the screen
- * Erase from the cursor to the end of the line
- * Turn on screen highlighting
- * Turn off screen highlighting

You will be asked a series of questions. To answer, enter a decimal number and then press RETURN.

To continue, press RETURN

To quit, press ESC

This display is intended to remind you of the complexity of the information that is required. The following sections of this appendix discuss each of these six control code functions in more detail.

There is a blank control code form at the end of this Appendix. You should read your terminal manual along with this Appendix and record each of the control sequences as you discover them. After you have installed your program and tested the codes, we would appreciate receiving a copy of the completed form so that we can include your terminal in the TERMINAL SELECTION menu and thereby eliminate this chore for others in the future.

APPENDIX B: TERMINAL CONTROL CODES

Clear Screen and Home Cursor

This is a mandatory function that is used very frequently.

CLEAR THE SCREEN AND HOME THE CURSOR (mandatory)

This character, or sequence of characters, should entirely blank the screen and leave the cursor in the upper left hand corner.

For example, an ADM3A terminal requires,

Number of characters in the sequence = 1
first character = 26 (an ASCII Control/Z)

To answer each question, enter a decimal number followed by RETURN
To quit, press ESC

The sequence that you enter here, and anywhere else for that matter, is limited to seven characters at most. This should be sufficient for any terminal.

The example given above is the ADM3A, a very common terminal. Looking in an ADM3A manual you might see the home and clear function defined in any one of the following ways,

By its ASCII name --> SUB
As a hexadecimal number --> 1A
As a control character --> CONTROL/Z
As an octal number --> 32
As a decimal number --> 26

Whatever is given in your manual, you must convert it into a decimal number before you can enter it. This should not be a problem, because most terminal manuals have conversion tables in the back.

The home and clear sequence may be a combination of two functions for your terminal (one to clear the screen and one to home the cursor). In that case, just combine the two sequences into one long sequence and enter in the decimal values.

Other terminals list a "lead-in" character that must follow each control code. If yours does, remember to include the lead-in character in the sequence.

As an example, specification of the ADM3A control codes is shown below with operator's entries shown in bold face.

How many characters are in the home and clear sequence? 1
What is the decimal value of character #1? 26

Position the Cursor

Positioning the cursor is probably the most complicated function that your terminal can perform. Because of the obscure way in which most terminal manuals are written, it may take you several tries before you successfully discover the proper control sequence. Don't despair, most people have difficulty with this one.

POSITION THE CURSOR (mandatory)

This is a complex sequence of characters used to move the cursor to a specific row and column of the terminal screen. The sequence required by most terminals can be generalized into five parts.

The general sequence is,

For example, for an ADM3A,

part 1 = a lead-in sequence	2 characters, 27 and 61
part 2 = the row number plus an offset	row number + 32
part 3 = a separator sequence	none required
part 4 = the column number plus an offset	column + 32
part 5 = an ending sequence	none required

By generalizing the sequence into five parts almost all terminals can be controlled. If your terminal's cursor positioning is simple you won't need to use all five parts. But if your terminal is more complicated, all five may be necessary.

There is one complication: some terminals want the column number first, not the row number. Make sure to check your manual for this odd behavior.

The lead-in sequence is a set of characters that tells your terminal to be on the look out for a cursor address.

The row number is sent with an optional offset. It is a conventional practice for computer programs to refer to rows of the terminal screen using the numbers 0 through 23, but some terminals refer to rows using the numbers 32 through 55 (these are just the same numbers but with an offset of 32). They do this so that they won't confuse a row number with some other control code. Because a row offset is so common, you will be asked to enter the offset used by your terminal.

Some terminals require a separator sequence between the row and column, but most terminals don't. If one is required it is probably due to the fact that you can independently position the cursor row and column location.

As with the row number, the column number may require an offset and this offset may be different from the row offset. For example, a Microterm ACT-V terminal uses a row offset of 32 and a column offset of 80 but most programs refer to terminal screen columns with numbers from 0 through 79. If the column offset is 32, then the numbers 32 through 112 are used instead. If a column offset is

APPENDIX B: TERMINAL CONTROL CODES

used that would make the column number greater than 126, then a value the numbers wrap back around to 0.

The fifth part of this general sequence is included for those terminals that require something to follow both the row and column numbers.

As an example, the following entries could be used for an ADM3A,

```
How many characters are in the lead-in sequence? 2
What is the decimal value of character #1? 27
What is the decimal value of character #2? 61
Is the row first for your terminal? Enter "Y" or "N"? Y
What offset, in decimal, is added to the row number? 32
How many characters are in the separator sequence? 0
What offset, in decimal, is added to the column number? 32
How many characters are in the ending sequence? 0
```

Erase to End of Screen

This is the first of the optional control codes. If your terminal does not perform this function, it will be simulated in software. Simulation in software will, of course, be noticeably slower.

ERASE TO END OF SCREEN (optional)

This sequence blanks the screen from the cursor position to the bottom.
If your terminal does not provide this function, it will be simulated in software.

Since this control sequence is used very frequently, it is highly desirable that your terminal have it. Although the ADM3A we have been using does not perform this function, most newer terminals do.

Does your terminal provide this function? Enter "Y" or "N"? N

Erase to End of Line

This is the second of the optional control codes. If your terminal does not perform this function, it will be simulated in software. Simulation in software will, of course, be noticeably slower.

ERASE TO END OF LINE (optional)

This sequence blanks the screen from the cursor position to end of line.
If your terminal does not provide this function, it will be simulated in software.

Since this control sequence is used very frequently, it is highly desirable that your terminal have it. Although the ADM3A we have been using does not perform this function, most newer terminals do.

Does your terminal provide this function? Enter "Y" or "N"? N

Turn On Highlighting

Highlighting is intended to be a function such as inverse video, a change in intensity, or any other function that calls attention to some area of the terminal screen. It is normally used by the program to accent one or more data fields in a screen display.

If your terminal is not capable of such a function, the program will not use and there will be no noticeable performance sacrifice.

The highlighting displays and the responses for an ADM3A terminal are shown below.

TURN ON HIGHLIGHTING (optional)

This sequence turns on screen highlighting such as inverse video or a change in screen intensity. On some terminals the highlighting attribute applies to fields and must be treated specially to prevent a distracting flashing of the screen. Sometimes the attribute itself uses a blank space on the screen.
If your terminal does not provide highlighting, it will not be used.

Does your terminal provide this function? Enter "Y" or "N"? N

APPENDIX B: TERMINAL CONTROL CODES

TURN OFF HIGHLIGHTING (optional)

This sequence turns off screen highlighting such as inverse video or a change in screen intensity. Since you have already specified a sequence to turn on highlighting, you must also enter this sequence.

How many characters are in the turn off screen highlighting sequence?

Special Terminal Options

SPECIAL TERMINAL OPTIONS

There are several special options that are required by a few terminals. Use the normal answer unless you are absolutely sure your terminal is different

How many NULLS are required after erasing the screen? (Normally 0) 0
Are cursor addresses sent as strings? (Normally NO) Enter "Y" or "N" N
What is the cursor origin? (Normally 0) 0

TERMINAL CONTROL CODE FORM

Terminal Manufacturer _____

Model Number _____

CLEAR SCREEN AND HOME CURSOR

Decimal values of the characters = _____

POSITION THE CURSOR

Decimal values of lead-in sequence = _____

Is the row value sent first? (circle one) = Y N

Row offset = _____

Decimal values of separator sequence = _____

Column offset = _____

Decimal values of ending sequence = _____

ERASE TO END OF SCREEN

Decimal values of the characters = _____

ERASE TO END OF LINE

Decimal values of the characters = _____

TURN ON HIGHLIGHTING

Decimal values of the characters = _____

Do attributes apply to fields? (circle one) = Y N

Do attributes occupy a space? (circle one) = Y N

TURN OFF HIGHLIGHTING

Decimal values of the characters = _____

SPECIAL OPTIONS

Number of NULLS after home and clear = _____

Send Cursor Addresses in ASCII (Normally No) = _____

Is Zero The Cursor Origin (Normally Yes) = _____

APPENDIX B: TERMINAL CONTROL CODES

TABLE OF ASCII CHARACTERS

Use this table to find the decimal equivalent of ASCII characters used to control your terminal.

CHAR	CTRL	HEX	DEC	CHAR	CTRL	HEX	DEC	CHAR	CTRL	HEX	DEC
NUL		0	0	,	2C	44		X		58	88
SOH	^A	1	1	-	2D	45		Y		59	89
STX	^B	2	2	.	2E	46		Z		5A	90
ETX	^C	3	3	/	2F	47		[		5B	91
EOT	^D	4	4	0	30	48		\		5C	92
ENQ	^E	5	5	1	31	49		]		5D	93
ACK	^F	6	6	2	32	50		^		5E	94
BEL	^G	7	7	3	33	51				5F	95
BS	^H	8	8	4	34	52				60	96
HT	^I	9	9	5	35	53		a		61	97
LF	^J	A	10	6	36	54		b		62	98
VT	^K	B	11	7	37	55		c		63	99
FF	^L	C	12	8	38	56		d		64	100
CR	^M	D	13	9	39	57		e		65	101
SO	^N	E	14	:	3A	58		f		66	102
SI	^O	F	15	;	3B	59		g		67	103
DLE	^P	10	16	<	3C	60		h		68	104
DC1	^Q	11	17	=	3D	61		i		69	105
DC2	^R	12	18	>	3E	62		j		6A	106
DC3	^S	13	19	?	3F	63		k		6B	107
DC4	^T	14	20	@	40	64		l		6C	108
NAK	^U	15	21	A	41	65		m		6D	109
SYN	^V	16	22	B	42	66		n		6E	110
ETB	^W	17	23	C	43	67		o		6F	111
CAN	^X	18	24	D	44	68		p		70	112
EM	^Y	19	25	E	45	69		q		71	113
SUB	^Z	1A	26	F	46	70		r		72	114
ESC	^[	1B	27	G	47	71		s		73	115
FS	^\	1C	28	H	48	72		t		74	116
GS	^]	1D	29	I	49	73		u		75	117
RS	^^	1E	30	J	4A	74		v		76	118
US	^-	1F	31	K	4B	75		w		77	119
SP		20	32	L	4C	76		x		78	120
!		21	33	M	4D	77		y		79	121
"		22	34	N	4E	78		z		7A	122
#		23	35	O	4F	79		}		7B	123
\$		24	36	P	50	80		}		7C	124
%		25	37	Q	51	81		}		7D	125
&		26	38	R	52	82		~		7E	126
'		27	39	S	53	83		DEL		7F	127
(		28	40	T	54	84					
)		29	41	U	55	85					
*		2A	42	V	56	86					
+		2B	43	W	57	87					

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